SEMI-CENTENNIAL EDITION

TRANSACTIONS
AND
YEAR BOOK

Vol No. 49

SCITE ET STRENUE

UNIVERSITY OF TORONTO
ENGINEERING SOCIETY

APRIL, 1936

SEMI-CENTENNIAL EDITION

TRANSACTIONS

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UNIVERSITY OF TORONTO
ENGINEERING SOCIETY

APRIL, 1936

CONTENTS


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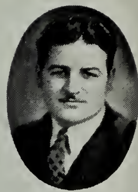
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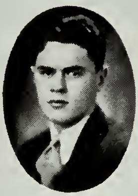
TORONTONENSIS REP.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Faculty of Applied Science and Engineering

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1935 1936


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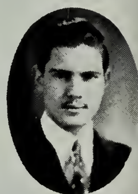
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TRANSACTIONS AND YEAR BOOK

of the

University of Toronto Engineering Society

No. 49 APRIL, 1936

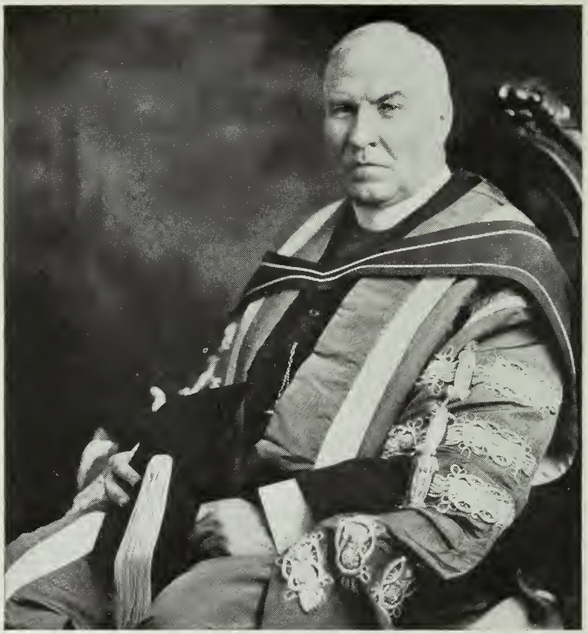
When we took on this job of publishing the 1936 edition of TRANSACTIONS AND YEAR BOOK, we pictured ourselves changing a few dates, shoving in new faces, and generally doing what is commonly regarded as a routine operation.

No fanfare of brassy trumpets started off the year last September, but after a few weeks had disappeared, and also after we had acquiesced into taking the job, the executive of the Engineering Society, and particularly that hustling man, President Lawrason, made it evident that this was to be an unusual year. To begin with, they discovered that our Society was fifty years old, and, at the same time, they began to do the regular run of things, such as School Dinner, School Nite, and so on, in a most ambitious manner. As if it were not simply enough to plan a semi-centennial celebration and do the ordinary things a little better than they had been done before, the executive carried out a successful program of putting all our records and systems in good order and shape.

As a group that has, in a sense, both sat in on things and at the same time watched from the fence rail, we have been greatly impressed with the capable way in which our President and his officers have conducted their meetings and affairs.

As long as there are engineers, the year that has passed with our society will be remembered with great distinction. Of all the forty-nine Boards of Editors of "Transactions and Year Book" that have so far existed, it has been our singular pride and joy to preserve this most important chapter in the history of the University of Toronto Engineering Society. We blush.

T. S. B.



THE HON. AND REV. H. J. CODY, M.A., D.D., LL.D.
President of the University of Toronto

A Message from the President

To the members of the ever vigorous Engineering Society, present and past, I offer the congratulations of the whole University on the occasion of this fiftieth anniversary of the founding of your organization. A fiftieth year is a jubilee year—a year, as the name implies, of rejoicing. You look thankfully back over the days gone by as you remember the services which the Society has rendered to your Faculty, to your members, and to the whole community; and you look hopefully forward to future years of fellowship, of mental stimulation and of strengthening the fabric of engineering efficiency.

From the beginning of your activities you were encouraged by the members of the teaching staff to conduct your business and carry on your general work by yourselves. You grew strong under the responsibilities that were placed upon you. Burdens may be heavy to carry, but they make strong men. One of your songs asks the questions—"Who always make the most of life? Who takes the bumps of life with calm?" and confidently answers: "Engineers." Well, no one can take the bumps of life calmly unless he knows what life really is and can make the most of its opportunities. Your whole course of training insists on thoroughness, accuracy, scrupulous regard to fundamental laws, constructiveness and co-operation. These elements when combined do help to make a worthy life; and the knowledge that what we are trying to do is worth while, even though it involves many a bump, will give us calmness, and equanimity of soul.

I wish to express my appreciation of your continuing loyalty both to your Faculty and to the University. Among graduates no group is more enthusiastic than are your members for the well-being and progress of your *Alma Mater.* Keep this fire of loyalty brightly burning. The University of Toronto needs your goodwill, your interest, your support, your power to form and maintain public opinion in favor of giving educational advantages, even the highest, to those who are fitted to profit by them. I would like to see established by graduates a goodly number of scholarships in Applied Science and Engineering to provide such opportunities.

It is obvious that engineers play a great part in the material development of this country. You can play an equally important part in furthering the higher life, the life that is devoted to the things of the mind and the soul. One much needed lesson, the value of discipline, your whole professional life has taught you and has fitted you to teach to others. A modern essayist well says: "The idea that we have a right to an easy existence, that in so far as it is difficult we suffer wrong and have a grievance, and that therefore the path of progress lies in the direction of making things easy all round—that idea is deeply embedded in the modern mind." But it is a fatally mistaken

idea. You know that hard work and discipline are necessary if any really good result is to be obtained.

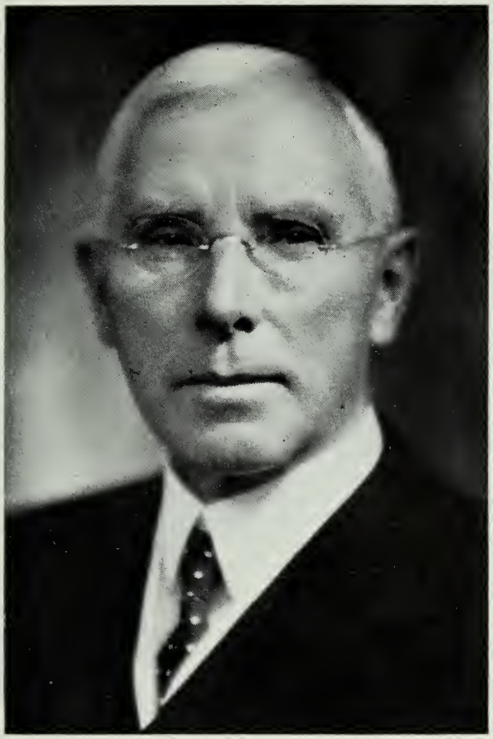
As opportunity may arise, take an active interest, (so Dr. Morris forcefully reminded you) in the public life of Canada. You have a distinctive contribution to make to the good government of your country and I hope that you will have the chance to make it. For democracy is less a system of equal rights than a system of equal responsibilities; and you share these common responsibilities of citizenship.

Your Society has a fine motto, *Scite et strenue*, skilfully, with fulness of knowledge and strenuously, with fulness of practical effort. It is applicable both to undergraduate and to graduate days. Go out with hope and confidence into a Canada that in the long run must grow and offer broad fields of opportunity to its sons; use your knowledge and your energy, and build both knowledge and energy on fundamental and God-given integrity of character.

I wish increasing success to your Society during the next fifty years, and I hope you will always be able to "take the bumps of life with calm."

H. J. Cody,
President University of Toronto.

The Dean's Message for 1936



To the Members of the Engineering Society:

Gentlemen:

The past year has been unique in the history of the Engineering Society. Not only has the ordinary regular work of the Society been highly successful, but the extraordinary side of the year's activities has been outstanding in respect to the celebration of the Society's Semi-Centennial.

Much has been said and written with regard to the reunion and celebrations of the fiftieth year of the Society's life. The month of February, 1936, will always be a month to remember by all those of the thousand graduates and undergraduates who were present at that memorable afternoon when the reunion took place. Let us cherish the memories.

The President, the Officers and the members of the Engineering Society are greatly to be congratulated upon the singular success of

the reunion and celebration, and indeed upon the whole season's activities.

You who are graduating this year are indeed fortunate in going out into a world which is in a considerably better frame of mind to receive you than during the past few years. The omens are much better for the engineering profession generally and for the graduates of this Faculty in particular. The year 1936 will undoubtedly be a better "jumping-off place" than some of the recent years in Canada.

Be sure you seize your opportunities with energy and judgment and whatever you may set your hands to, be sure to work at your best efficiency whether, for the time being, it be ninety per cent. or one hundred and ten. Sometimes the overload, if you can stand it for a while, is just the thing to bring success later.

To the members of the Society who will be back next year, I wish to pass a word of encouragement and congratulation as well. We graduates know how we all used to look forward to the next year at college and all that it might unfold. In the meantime, do the best you can in your examinations and get the best kind of experience you can in the coming vacation. You know, "any experience is good for an engineer."

To all years may I offer best wishes for the coming year and to the graduating class my best wishes for good fortune out in the world.

Yours faithfully,

C. H. Mitchell,
Dean.

The Society President's Message

Gentlemen:

This has been a very active year for the Engineering Society. It has grown steadily since it was founded in 1885 by our good friend, Dr. T. Kennard Thomson, whom we had the pleasure of entertaining at our Semi-Centennial Convention. It has earned the reputation of being the strongest and most active Society on the campus. This has been made possible only through the loyal support and co-operation of its members who have never failed to play their part in the various affairs of the Society.

It will not be necessary for me to review the proceedings of the past year since a detailed report is given in the following pages. I should, however, like to take this opportunity to thank the members of my Executive Committee and also the members of the Special Committees for their loyal support and co-operation and to congratulate them on the success of their plans for the various functions during the past year.

I am sure that the members of these Committees feel that they have been well repaid by the appreciation that you have shown for their work. The experience that they have gained in the planning of the many Society affairs will be of great value to them.

It is impossible for one to really appreciate the value of an organization without first having had an opportunity to take part in the planning of its various functions. Although the Executive Committee consists of only eighteen members, over one hundred undergraduates take part in the management of Society affairs. Besides this permanent staff, it is necessary to enlist the services of additional members to act on special committees which are formed throughout the year.

This year our Society celebrated its Fiftieth Anniversary by holding a Semi-Centennial Convention. At this time we had the honour of entertaining the founder of our Society, Dr. T. Kennard Thomson, and several of his College fellows who were present with him at the inaugural dinner of the Society. The occasion was made even more singular by the presence of the first graduate of our Faculty, Dr. J. L. Morris of the Class of 1881. About one thousand members attended this Convention, including over two hundred graduates.

The interest that is shown in the Society by its members has always been quite evident. The last general elections served to verify this, when ninety-two candidates competed for thirty-six offices. It is, therefore, not necessary for me to appeal to you for support but merely to remind you that the continued success of the Society depends on your maintaining this active interest.

In looking over the records for the last fifty years, it is interesting to read the papers prepared by members of the Society that have since distinguished themselves in the field of engineering. These papers are not only valuable as the first work of men who have since become prominent, but are permanent records of the progress of the engineering profession. For example, it was only during the life of our Society that electrical apparatus has reached its present day perfection.

This year an attempt has been made to properly protect the past records of our Society. At a dinner given in honour of Dr. T. Kennard Thomson at the close of our Semi-Centennial Convention, Professor H. E. T. Haultain, our first student President, suggested that a new Society be formed. He then made the following motion which was seconded by Dr. J. M. R. Fairbairn.

> "That there be established the "Galbraith Society" and that an executive committee be appointed consisting of:—
>
> Honorary Chairman, Dr. T. Kennard Thomson; Chairman, Dr. T. H. Hogg; Vice-Chairman, Mr. W. D. Black; with power to add to their numbers."

This Society was named in honor of our first Dean, Dr. John Galbraith, its object being to prepare and properly record the history of the Engineering Society from the days when it was first conceived by its founder, Dr. T. Kennard Thomson.

It has been a pleasure and a great honor to serve you as your President. I want to thank you for the loyal support and co-operation that you have given me throughout the year, and I hope that I have been able to justify the trust that you placed in me when you elected me to office. You have given me the opportunity to become very fond and very proud of the Society, and it is with considerable reluctance that I give up my office to our new President, Mr. H. N. Potter. I know that you will give him the same support that you gave me. In closing, I want to congratulate him on being elected to this office and to wish him, his Executive Committee, and the Engineering Society, every success for the coming year.

TRANSACTIONS

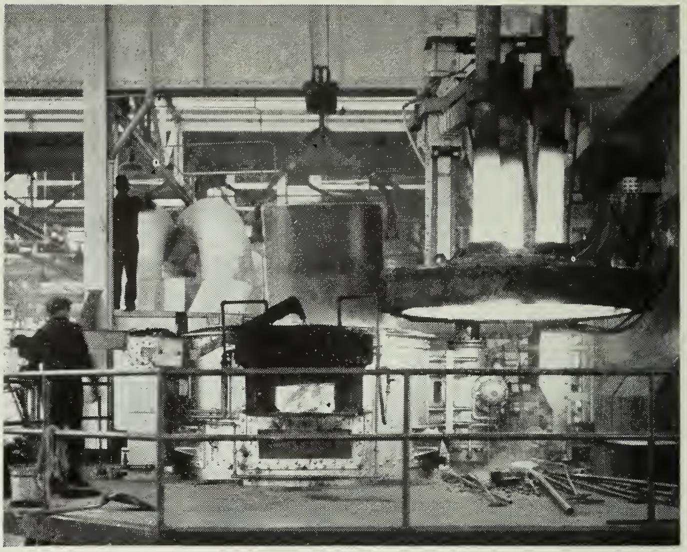


Fig. 1—Charging the Five-ton Electric Furnace.

Fig. 2—Rotary Core-Making Machine.

Figures Nos. 1, 2, & 6 are reproduced from an article on the "Electric Furnace Foundry of the Ford Motor Company of Canada, Limited," in The Engineering Journal for June, 1935.

Sand Casting of Crankshafts

Condensed from a thesis for the degree of B.A.Sc. in Mechanical Engineering, by Reginald L. Miller.

During the winter and spring of 1935 the Ford Motor Co. of Canada erected and equipped a foundry at their main plant in Windsor for the production of cast alloy—steel crankshafts to be used in their V-8 engines. The process of casting the alloy-steel crankshafts was developed in the River Rouge plant of the Ford Motor Co. in Detroit, and the foundry in Windsor is similar to the one at Detroit, although built on a smaller scale. The foundry represents the most modern development with respect to layout, construction and equipment. Due to the large use of windows in the walls on all four sides, together with additional windows in the roof, the lighting is entirely natural except on very dark days. Ventilation is provided by means of an elaborate piping system and large fans which blow air through a water spray in summer and through steam coils and a water spray in winter.

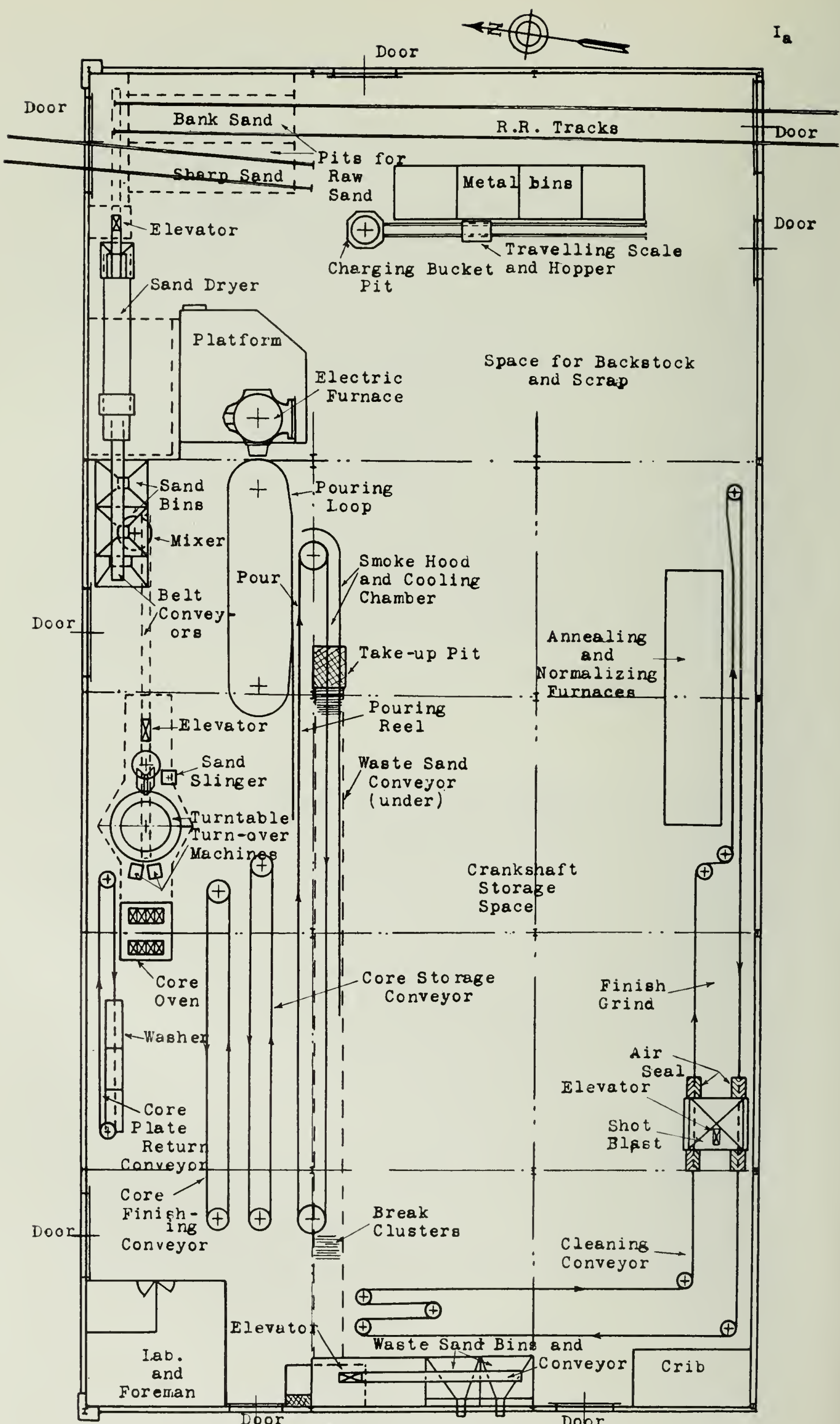
The proposed layout was for a production of 400 crankshafts per 16-hour day, but 500 crankshafts are now being produced per day of 8½ hours. To meet increased production demands the foundry could be operated on two or three shifts by means of which up to 1400 crankshafts could be produced in 24 hours. The layout shown on the following page shows the arrangement of the equipment in the foundry and will supplement the description of the sequence of operations followed in the production of the completed castings.

Speed and efficiency of production are desired in each operation, and these requirements are met by the use of conveyors of various kinds wherever a transfer of materials such as cores, core plates, molds, etc. from one part of the building to another is required.

Core Room

The production of the crankshafts is entirely a dry sand proposition, hence the layout is that of a core room. The Green End refers to that part of the room devoted to the drying, mixing and forming of the sand into the cores; the Dry End refers to that section of the room devoted to the baking, washing and inspection of the cores and their assembly into molds.

The crankshafts are molded in groups of four with a large sprue in the centre. This sprue runs from top to bottom of the mold and varies in diameter from 5 inches at the top to 1 inch at the bottom. The mold is made up of 16 flat cores of varying thicknesses, running from 3.5 inches to 1.4 inches, each core containing openings, or prints, to form the part of the castings at that particular plane. Each core contains four of these openings. In addition, between alternate pairs of cores, two locator cores are placed in holes tapering from 2¼



FORD FOUNDRY LAYOUT
Scale: I"=I6'-0"

inches to 2 inches, in each core, and these pins or locator cores serve to locate the upper core with respect to the one immediately beneath it. The large cores are all numbered from 1 to 16, and in building up the mold they are assembled vertically, starting with No. 1 on the bottom, No. 2 next, and so on until the mold is complete. The top core, or No. 16, contains the pouring basin, or runner-head, and four large riser openings, continuations of each of the crankshafts. A small core, called the Strainer Core, is placed in Core No. 15 at the base of the runner-head in each mold. This Strainer core is 1½ x 7 x 4 inches in size and contains 12, 11/32-inch holes; these cores act as strainers and prevent foreign matter from entering the castings.

Green End

There are two kinds of sands used in making the cores, namely, bank and sharp sand. Loaded cars containing the sand enter the building on double spur tracks and the sand is allowed to fall from the cars through floor gratings into large bins below the floor level. The bank sand is stored in one bin and the sharp in another. A system of endless belt conveyors carries the sand to an elevator where it is carried aloft. The bank sand, as received, is usually very dry, and unless the moisture content exceeds 6%, as rarely happens, it is carried on another belt conveyor, directly to a 16-ton capacity bin located over the mixer. The sharp sand on the other hand, as received, is usually very wet and consequently it is discharged from the elevator into a long revolving drum where it is dried at a temperature of from 300 to 350° F. The sand is then discharged on to the conveyor and dumped into a 23-ton capacity bin, also located above the mixer. Each bin is provided with gates at the bottom, and a small graduated steel hopper running on trolley rails is used to transfer given quantities of the sand from the bins to the mixer. The mixer is a No. 2 Simpson Mixer of 1,000 lb. capacity and is situated on the floor level. Its action is more in the nature of a mulling effect, which breaks down the grains of the sand while the flow carries out the proper mixing. After mixing, the sand falls through a trap in the mixer on to a belt conveyor which carries it to a bucket-type elevator. This elevator carries the sand aloft and discharges it into a circular tank which in turn delivers the mix through a hopper to the sandslinger. The sandslinger is supplied by the John T. Hepburn Co., Toronto, and is fitted with a 16-inch head, a 16-inch impeller, and is operated by a 15 H.P. motor running at 1200 R.P.M. When operated to capacity the sandslinger can handle 400 cores per hour. The sandslinger and circular tank are synchronized in action, so that sand is only delivered to the sandslinger when it is running. The sandslinger delivers the sand to core boxes located on a circular turntable which revolves beneath it. There are 16 core-boxes on the turntable and one complete revolution of the table produces 16 cores, or 1 mold. Surplus sand from the boxes falls through a grating in the turntable and is collected on a belt conveyor which carries it back to the elevator mentioned

just previously. After the cores are made they are taken from the boxes and placed on core-plates on shelves in a drying oven

The bank sand contains a considerable quantity of clay and is used to keep the core from sagging before baking. It also produces a smooth finish on the core. The sand consists of the following approximate chemical analysis:—

Loss on Ignition	1.01%
Silica	92.09%
Iron Oxide and Aluminum	6.09%
Magnesia	0.22%

The following is an approximate sieve test:—

Retained	on	20	mesh	0.03%
"	"	40	"	0.61%
"	"	70	"	12.15%
"	"	100	"	24.68%
"	"	140	"	32.38%
"	"	200	"	21.75%
"	"	270	"	4.53%
"	"	pan	"	2.80%

Sharp sand contains practically no bond or, in other words, the aluminum and ferric oxide content is practically nil. This sand resists the eating-in effect of the metal and is a natural vent in itself due to the round condition of its grains. It possesses the following approximate chemical proportions:—

Loss on Ignition	1.01%
Silica	98.25%
Iron Oxide and Aluminum	0.54%
Lime	0.34%
Magnesia	0.86%

The following is an approximate sieve test:—

Retained	on	20	mesh	1.0%
"	"	30	"	2.0%
"	"	40	"	7.0%
"	"	70	"	60.0%

Balance retained on 100 mesh.

As there is not sufficient resistance to the high temperature and scouring action of the metal when pouring the mold with the two sands mentioned, a silica flour is added to enhance the resistance of the mix. This silica flour has a chemical content of approximately 99% silica with the other 1% made up of the alkalies magnesia and lime. It is pulverized to a consistency which enables it to pass a 140-mesh sieve.

The only natural bond present in the three commodities listed above is the ferric oxide and aluminum in the bank sand. In order to hold the core in its ideal shape and condition, both in the green,

that is before baking, and in the dry, that is after baking, conditions two binders are used—a cereal binder, and raw linseed oil.

The cereal binder is a corn product and acts like flour or starch in holding the perfect shape of the core while green. From the time the core is drawn from the box until it is placed in the oven, sagging of any description must be avoided, otherwise it would be impossible to hold the castings to an overall allowance of 30/1000-inch as is now specified. This cereal binder is purchased on the basis of 390 to 415 grams per quart.

Raw linseed oil is the ideal binder and is the base of all core oils. Its work does not commence until the core is baked. A linseed oil core is freer from smoke and gas than a cereal core, hence the condition around the pouring and cooling areas is better when linseed oil is used. Also, cereal binder cores have a tendency to draw moisture if allowed to stand in storage over 24 hours, while linseed oil cores are entirely free from this detriment. However, a certain portion of cereal binder is essential in the mixture in order to ensure the core retaining its shape both before and after baking.

The three constituents—silica flour, cereal binder and raw linseed oil, are all added to the sands in the mixer. Two core mixtures are used in making the cores, namely:—Regular, and Special.

The special mixture is used in making the locator cores, the strainer cores, and the large cores in boxes 4, 5, 10 and 11, while the Regular mixture is used in making all the other cores. The sand mix is figured by volume using the quart measure as standard. The following gives the weight in lb. per qt. of each ingredient used in the mix.

Sharp Sand	1 qt.—3.2 lb.
Bank Sand	1 " —3.0 "
Cereal Binder	1 " —0.88 "
Linseed Oil	1 " —1.94 "
Silica Flour	1 " —2.10 "

One batch of the Regular Mixture, therefore, consists of the following:—

Sharp Sand	210 qts.—672.0 lb.
Bank Sand	140 " —420.0 "
Cereal Binder	6 " — 5.3 "
Linseed Oil	6 " — 11.6 "
Silica Flour	12 " — 25.2 "

This gives a total ratio of binder to sand of 1 to 31, made up of 1 part linseed oil to 58 parts sand and 1 part cereal binder to 29 parts sand. If the bank sand is slightly dry, from 2 to 3% of water is added and the mixer run for 5 minutes.

A stiffer and heavier mixture is required in making the locator and strainer cores and Cores No. 4, 5, 10 and 11, and to obtain this special mixture, the proportions of linseed oil, cereal binder and silica flour are increased. This sand has greater strength and higher

resistance to the eating-in effect of the hot metal than has the sand in the regular mix.

The sand, after mixing, is delivered to the sandslinger by the conveyor, elevator and circular tank. Each batch weighs approximately 1100 lb., which is slightly over rated capacity for the mixer, but this increase is made necessary because of the fact that it requires approximately 500 lb. of sand to fill the 16 core boxes, or, in other words, produce one mold. Spillage losses amount to 10%, hence, allowing for spillage, one batch of sand produces 2 molds or 8 crankshafts. With a production of 400 crankshafts per 8-hour day, 100 molds per day are required, 50 batches of sand per day, or approximately 55,000 lb. of Regular mixture per day.

Of the Special mixture, 2 qts. are used in each of the core boxes 4, 5, 10 and 11, in which the Special sand is packed immediately around the crankshaft prints. The rest of the box is then filled with Regular mix. For 100 molds, 800 qts. or 2480 lb. of sand are required.

The locator cores weigh 2.42 oz. each and as there are 14 cores per mold, 1400 cores per day are required. 211 lb. of mixture are required in making these cores.

The Strainer cores weigh 10.6 oz. each and as only one Strainer is used per mold, 100 Strainer cores per day are required, 67 lb. of sand per day being used to make these cores. This gives a total of 2758 lb. of Special mixture required per day, or allowing for 10% spillage, a total of 3033 lb. per day. This is obtained by making three batches of the Special mixture.

The Special sand used at the turntable is delivered to a hopper situated just outside the turntable near the sandslinger. The locator and strainer cores are made on a small bench located near the special hopper from which the workman engaged in making the small cores obtains the Special sand.

Making the Cores.

The complete mold consists of 31 distinct cores. Of these 31 cores, 14 Locator cores and 1 Strainer core are made up on the bench, while the balance, 16, are made on the turntable. The castings themselves are really produced from the 16 cores made on the turntable.

There are twelve distinct operations performed at the turntable, as follows:—

(1) Clean Core Box:

This is carried out by means of a spray, using a mixture of 19 parts kerosene and 1 part linseed oil. After spraying, the boxes are dried with a blast of air. In boxes 4, 5, 10 and 11 a round paint brush is used to get down into the core points. It may be explained that these core points are small tapering pins about two inches long which stand up from the face of the core and produce the holes in

the flanges of the crankshafts, called "lightener" holes, in the finished castings. There are 4 core points on each of cores 4, 5, 10 and 11.

(2) Place in Sand:

This operation consists of placing the Special sand in boxes 4, 5, 10 and 11, a special stick being used for ramming. Also, a layer of Regular sand is placed in the bottom of each box before it goes under the sandslinger, thus reducing the erosive action of the sand from the sandslinger when filling the box.

(3) Place in Wires:

In core boxes 4, 5, 10 and 11, a piece of No. 9 black, annealed wire, 2 5/8 inches long, is placed in the core points; 1 5/8 inches of the wire projects into the point and 1 inch protrudes into the body of the core. The wires are annealed to take all the spring out of them, and before placing in the boxes, they are dipped in linseed oil to make the sand adhere to them. The wires prevent the points from breaking off during cleaning and assembling.

(4) Filling the Cores:

The core-boxes are filled by means of the sandslinger which, when running at full capacity, supplies 400 cores per hour, 25 molds per hour, or 100 crankshafts per hour. The action of the sand from the sandslinger is extremely abrasive, as it delivers sand at the rate of about 3.5 lb. per sec. In filling the box, the slinger is taken across the centre of the box, then around the edges and the whole box finally filled to about 2 inches above the top of the box. This machine gives the most natural ram to the core that can be obtained, as it rams in layers and the sand is well packed.

(5) Tamp Around Edge of Core Box:

This operation is carried out by means of a hard rubber peever fitted to a pneumatic air rammer. This operation is necessitated because of the fact that the sandslinger does not always pack the corners of the box solidly. If the corners were weak, the core would crumble while being handled in the dry state and on assembling the mold. This tamping, or peening, ensures a solid surface edge to the core, which is very essential in this job.

(6) Butt Ram all over:

This operation is performed with a pneumatic air rammer, using a disc end. Butt ramming covers the entire core with the exception of the corners, and is used for the purpose of packing the entire core solidly.

(7) Strike-Off (Rough).

When the box comes from the Butt Rammer there is from 3/8 to ½ inch of surplus sand on it which must be removed so that the core is exactly the same depth at all points as the edges of the box.

(8) Strike-Off (Finish):

This is one of the most important operations in the making of the crankshafts, and it is only by paying close attention to the finish strike-off that the foundryman is able to hold the overall dimensions of the crankshafts to the required limits. The core, when removed from the box, should possess the exact depth measurements of the box at all points.

(9) Place on Core Plate:

The core plates are made of cast iron, size $\frac{3}{8}$ x $21\frac{1}{2}$ x 21 inches, and well ribbed so they will hold their shape when going through the oven. The core plates are placed on top of the boxes after the finish strike-off, and are inspected daily to see that no warpage has occurred, as the shape of the cores would be destroyed were the plates to sag or deform in any way.

(10) Turn Over:

After placing a plate on it, the box and plate are drawn over rollers onto the table of a 22 inch, type C.E.F., International Molding machine with a 5-inch draw and fitted with a pneumatic vibrator. The core plate and box are then clamped together and rolled over by the machine so that the box and core rests on top of the plate on the table of the machine.

(11) Draw Core and Return Box:

After turning the box over, the clamps are released, the vibrator turned on and the core plate and core drawn away from the core box leaving the core sitting on top of the plate. The box is then returned to the turntable, the molding machine turned right-side up, and the core inspected for soft spots. If the core is in good condition at this point a perfect core should leave the oven.

(12) Remove to Oven:

The core and plate is picked up by hand and placed on the oven conveyor, care being taken not to jar or shake the core while so doing.

The locator cores are made in a 50 gauge box, i.e., every time the box is drawn 50 cores are produced. The strainer cores are made in a 10 gauge box—ten cores per draw of box. There can be no imperfections in the strainer cores, for were they to fail while pouring the castings, sand would enter the castings and render them worthless. The shapes and relative sizes of the strainer and locator cores are shown in the accompanying figure.

Dry End

The "Dry End" of the Core Room refers to the operations of drying, washing and inspecting the cores and assembling the molds. These operations are all carried out in the Core Oven and on the three conveyors shown in the layout, running parallel to each other.

Drying the Cores.

The drying or baking of the cores is carried out in a single compartment, continuous conveyor, vertical type core oven, 9 feet

2½ inches wide, 9 feet 6 inches deep, and 42 feet 1 inch high, with carriers 2 feet 1 inch high, 2 feet wide, 7 feet 5 inches long, each carrier having 3 shelves with variable spacing. The oven is furnished with two velocity-type burners, each burner having 1,500,000 B.T.U. per hour capacity, using natural gas at 25 lb. per square inch pressure.

The oven contains 36 racks, with 3 shelves per rack, and when filled to capacity, 4 cores per shelf, it holds a total of 432 cores, which is equivalent to 108 crankshafts. Hence, to produce 400 crankshafts per 8-hour day, the oven has to bake approximately four complete fillings. From the time the cores enter the oven, until removal after baking, 2 hours and 20 minutes is taken up and the cores are baked at a temperature of from 400 to 420° F. If over-baked, the cores become burnt and crumble to powder; if under-baked or green, a large volume of gas will be released when the mold is poured, causing blow holes. A core slowly baked at the proper temperature produces the best condition for pouring.

After baking, the cores are taken from the oven and placed on the finishing conveyor. The locator and strainer cores, however, are placed in boxes for use as required. Before packing, the strainer cores are each dipped in a core wash, the composition of which will be described later.

The core plates are removed from beneath the large cores, sprayed with a mixture of kerosene and light machine oil, then hung on a conveyor which takes them through a washer and then back to the turntable.

Finishing.

After placing the cores on the finishing conveyor, the finishing operations, of which there are seven, follow.

(1) Gauging and Patching.

Gauging consists of placing a straight-edge on the face of the core to make sure that it is perfectly level. If not level, the face is rubbed down with carborundum stone until it is. However, if the core has sagged considerably, it should be scrapped. Each of the 16 cores has a depth gauge as only two sets, No. 5, 7, and 8, and 4 and 11 have the same thicknesses.

Patching the cores is seldom required if the core boxes are thoroughly cleaned between fillings, but occasionally small portions of sand stick to the boxes after drawing the cores and if not too large, these holes in the cores may be patched up before the core goes farther.

(2) Brushing with Core Wash:

It is necessary to brush the core points with a core wash on cores 4, 5, 10 and 11, and the prints of the shaft of the crankshaft proper. This is done to enable the sand to withstand the washing and eating-in effect of the metal and the operation is performed by hand, using a small 2 inch brush.

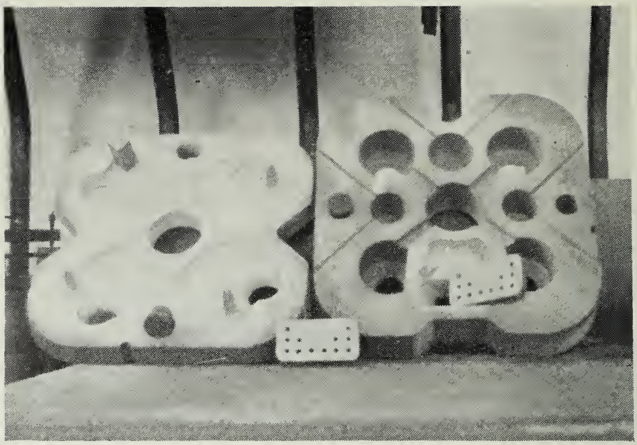


Fig. 4.—Cores Nos. 10 & 15 with Core Points on No. 10 and Strainer Core in Runner-Head opening of No. 15.

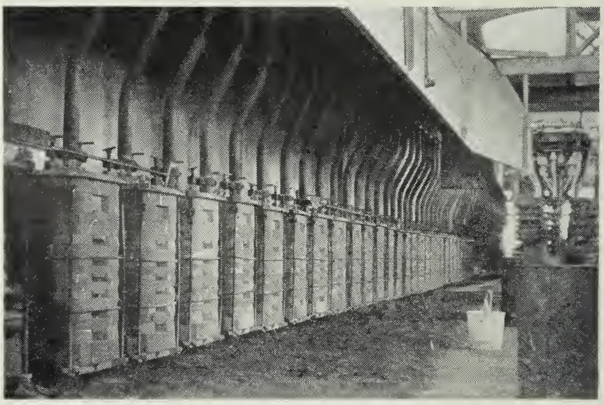


Fig. 5—Assembled Molds Ready for Pouring.

The following materials are used in making up the score wash:

Bentonite Paste	15	qts.
Glutrin	2	"
Silica Flour	40	"
Clay Flour	20	"
Water	70	"

(3) Spray:

The balance of the faces of the cores not washed by hand are sprayed, by means of compressed air, with a core spray solution which consists of the following ingredients:

Bentonite Paste	15	qts.
Glutrin	1.5	"
Silica Flour	30	"
Water	70	"

The core wash and spray are made up in 150 gallon tanks, provided with agitators run by compressed air. The agitators must run day and night to ensure the perfect suspension of all the ingredients in the mixtures. The wash and spray are used to reduce the burning-in effect of the metal to a minimum.

(4) Oven:

After the cores are brushed, washed and sprayed, they are passed through a small oven, about 6 feet long, equipped with gas jets which play on the face of the cores as they pass through, drying the core and leaving a fine white filament wherever the wash or spray has been applied.

(5) Touch Up:

The workmanship with respect to the wash and spray is inspected after the cores leave the small oven, and any spots that have been neglected are brushed with the wash or spray.

Also, at this point the positions of the wires in the core points in cores 4, 5, 10 and 11 are checked and if any portions of the wires are protruding from the points, the protruding surface is carefully coated with a film of core wash.

(6) Place Chills and Final Inspection:

In the final machining process in the machine shop, the casting has an oil hole drilled in the first flange. At first, difficulty was encountered in holding the drill true, and to overcome this, 4, copper-coated, cold-rolled steel chills, ¾-inch diameter and 2⅜ inches long, are inserted in prints in core 3. Only one chill is used per casting. The chills are embedded in a high temperature paste, and as the chills are heated before insertion, they take a very firm seat and any sweating before pouring is eliminated.

The final inspection consists of going over each core, and making sure that they are all in first class condition for storage. The firmness of the chills should be checked, the uniformity of the wash and spray finish, the tendency of the cores to crack, and the position

and condition of the wires should all be carefully inspected at this point, as the class of castings produced depends entirely on whether or not the cores are all in perfect shape before assembly into molds.

(7) Transfer to Storage:

This operation consists of transferring the cores from the finishing conveyor to the storage conveyor, running parallel to it, and on the shelves of which the cores are filed in numerical order with Core No. 16 at the bottom and No. 1 at the top.

(c) Mold Assembly:

The assembly of the molds is carried out on hangers or carriers of a third conveyor running parallel to the finishing and storage conveyors, but considerably longer. The conveyor has a capacity of 142 molds when full.

The bottom plate of the carrier holding the mold must be absolutely clean before commencing the assembly. This plate is provided with two locating prongs or points, cast into it, which fit into holes in No. 1 core. No. 1 core is placed on the plate with the green, or unwashed, face of the core down and the washed, or sprayed, face upward. No. 1 contains dummy gates which allow air to escape when pouring is started. No. 2 core is placed on top of No. 1 core with its sprayed face down and in contact with No. 1 core, the green side of No. 2 core being up. Locator cores (one at each side) are placed in holes provided in No. 2 core so that when No. 3 core is placed on No. 2, the cores will be fixed in position relative to each other. The cores are all placed in position in a similar manner, i.e. green faces together and sprayed faces together and locator cores between separate pairs of cores, as between 2 and 3, 4 and 5, 6 and 7, etc. At cores 4 and 10, iron bands are placed around the mold to prevent the sand from giving way after pouring. After placing core No. 15 in position, a strainer core is placed in the bottom of the runner head and a sheet of brown paper is placed on top of core No. 15 to keep any fine sand or dust from entering the mold. No. 16 is then placed on top of No. 15 without any locator cores being used between them, as No. 16 contains only the runner-head, sprue and risers, and no accurate alignment with No. 15 is required. Having now completed the assembly, a hinged weight is lowered into position on top of the mold and the tie rods at the four corners tightened down. The mold should be clamped down so securely that there is no chance for any metal to seep out between the cores.

Every core box represents a certain part of the casting, and should any trouble occur in any part of the casting it is easy to detect which core was at fault as the parting lines between the cores are shown on the completed casting, and by counting these lines, the number of the faulty core or core box can be obtained.

The mold is now ready to be poured.

The Melting Department

At the eastern end of the foundry building approximately one-third of the present total floor space is taken up by a craneway, in which a 5-ton crane operates across the width of the building. In this craneway are situated the electric furnace, the metal bins used for the storage of scrap steel, pig iron, etc., the pit for the charging

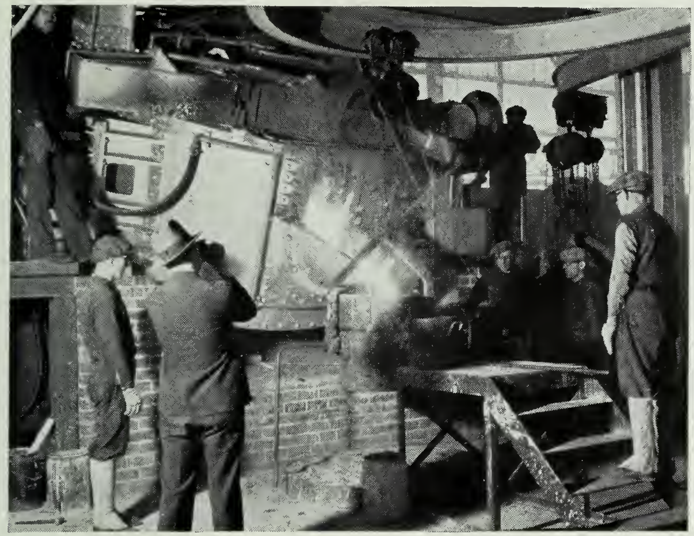


Fig. 6—Pouring from the Electric Furnace.

bucket, the charging bucket, and the hopper and scales used to weigh the scrap steel and pig iron used in charging the furnace.

The furnace is an Acid Lined, 9 foot diameter Swindell-Dressler Arc type with a nominal capacity of three tons. The furnace is equipped with 3 ten-inch carbon electrodes and has a removable top which is swung around to one side to allow charging. The scrap metal, pig iron, shavings, etc., used in making up the charge are weighed in the hopper of a travelling scale operating on a pair of narrow-gauge rails running alongside the metal bins. The power for the scale car is taken from a third rail on the side of the stock bins. After the scrap is weighed it is dumped into a charging bucket resting in a pit in the floor. When the charge is made up the bucket is picked up by the crane and lowered into the open furnace. When the bucket rests on the floor of the furnace, a catch on the bottom of the bucket is released and the charge rests on the bottom of the furnace when the bucket is removed. In moving the scrap metal around the craneway a large electromagnet, operated from the crane, is used.

The average weight of the charge melted in the furnace is about 8200 lbs. This charge will pour 18 molds, or is equivalent to 72 crankshafts, and allows the furnace to be operated on a 2½-hour cycle which is made up as follows:—

Melting down time	75 minutes
Refining	45 "
Pouring	15 "
Charging	15 "

From the accumulation, in the by-products department, of borings and scrap castings, scrap crankshafts, bundled stampings, tool steel, old boiler-plates, gears, etc., a charge of the following nature can be made up:—

		Chemical Analysis—%				
	Lbs.	C.	Si.	Mn.	Cu.	Cr.
Borings	2500	1.48	1.0	0.7	1.9	0.42
Stampings	2500	0.10	0.15	0.35	—	—
Forgings	1000	0.35	0.20	0.8	—	—
Pig Iron	2000	3.80	3.00	0.9	—	—
Tool Steel	100	1.00	0.20	0.9	—	—
100% Cu.	90	—	—	—	—	—
70% Fe. Cr.	35	—	—	—	—	—
Total	8225 lbs.					

This charge produces a metal of the following composition.

		Specifications call for:
Carbon	1.48%	1.40 to 1.60%
Silica	1.10	0.90 " 1.10
Magnesium	0.66	0.60 " 0.80
Copper	1.70	1.50 " 2.00
Chromium	0.43	0.40 " 0.50
Sulphur		0.06 and under
Phosphorus		0.10

Pouring Ladles

After the charge has been melted the molten metal is tapped from the furnace into a pouring ladle at a temperature of from 2800 to 2900° F. The pouring ladles, four in number, are of 1500 lb. capacity each, and travel around a pouring loop which passes near the tapping spout of the furnace and parallel to the mold assembly and pouring conveyor. The ladles are raised and lowered by hand using large chain blocks. The lining of the ladles is 2-inch Gannister, the composition of which is as follows:—

Crushed Silica Brick or Gannister	15 parts
Fire Clay	3 "
Cereal Binder	1 "
Silica Flour	1 "

Between pours the lining of the ladles is kept warm by inserting lighted gas jets in the ladles.

Six charges of 8225 lb. each are required each day to meet the schedule. All alloy additions of chromium, copper, silica or magnesium which may be required during the refining period are added to the bath of the furnace. However, if the scrap metal is properly tagged as to its carbon, silica and magnesium content when shipped to the foundry, additions rarely have to be made after the charge is melted and time is saved in the cycle.

Pouring the Mold

The pouring temperature of the steel is 2650° F., hence the temperature of the metal at the spout of the furnace should be 2800 to 2850° F. The pouring temperature of the steel at the mold is checked with an optical pyrometer, this operation being made necessary because, if the pouring temperature is in excess of 2650° F., a coarser crystalline structure than desired will be produced. A temperature drop of about 75° F. results during the pouring of the three molds, hence the initial temperature has to be watched closely or mis-runs are apt to result during pouring.

In order to reduce shrinkage to a minimum during the period of solidification, the mold has to be provided with risers, shrink gates and a special sprue to act as feeders while the metal passes from the liquid to the solid condition. The following description of the system of sprue, gates and risers will give an idea of the uniformity of cooling and small shrinkage resulting.

After entering the runner-head or pouring basin, the metal passes through the strainer core, which keeps out any slag or foreign material,

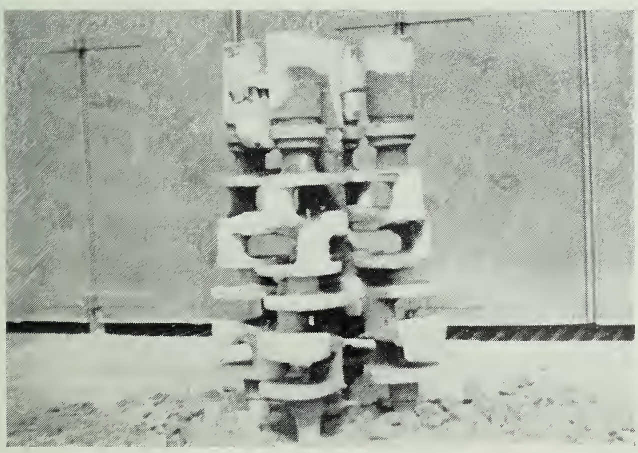


Fig. 5—Cluster of Four Crankshafts.

into a small trough which leads it to the large central sprue. This central sprue is shaped like a funnel, being 5 inches in diameter at the top in core 16 and tapering to a diameter of 1 inch, approximately, in core 1. Gates are located in cores 1, 6 and 7, with shrink gates in cores 8 and 9. The metal enters the cores at the gates in core 1, rises until the gates at 6 and 7 are reached, and then continues up until the risers and runner-head in core 16 are filled and the mold will take no more. The head of metal in the funnel-shaped central sprue forces liquid metal into the castings as long as liquefaction continues, with the result that an almost instantaneous uniform peening or ramming of the mass takes place until solidification is complete. The shrink gates act as reservoirs of hot metal, playing the same part as the sprue in keeping plenty of hot metal to that portion of the casting already poured, and represented in cores 1 to 7, while the mold is filling up from cores 7 to 15. The risers, runner-head and increased area of the sprue at the top of the mold repeat the action of the shrink gates in keeping the solidification process uniform throughout the entire casting, and the open risers, sprue, and runner-head are covered with a layer of peasive charcoal, after pouring, to prevent heat escaping from them too fast.

The result is a solid casting with no cooling cracks.

Cooling Down in Mold

After the molds are poured, they are taken around the conveyor into the smoke hood and cooling chamber, shown in the layout, at the end of the conveyor next to the furnace. The molds are then allowed to stand for 3 hours without being touched. This subjects the castings to a sort of annealing effect.

Knock Out

After the castings have been allowed to cool for 3 hours, cores 15 and 16 are removed, and each cluster of four crankshafts sprue, gates, risers and runner-head is attached to a vibrator which loosens the sand from the castings. The sand which clings to the castings is knocked out with steel bars and wooden mauls and all waste sand falls through gratings in the floor, under the pouring conveyor, upon a waste sand drag conveyor which carries it to an elevator and storage bins, from which it is disposed of with trucks. The sand is not reclaimed for further use as the cost of so doing is too great.

Cleaning

After removing the sand from the clusters, they are taken from the conveyor and placed on the floor, where, with the aid of a special crow-bar, the crankshafts are detached from the sprue, the risers removed from the ends of the crankshafts and the gates broken off. The sprue, risers, and gates are returned to the melting department as backstock. The crankshafts are then hung singly on a cleaning conveyor and a spot is ground on each with a hand grinder on which

the heat number is stamped. The wires are then removed from the core points of cores 4, 5, 10 and 11 by means of a pair of pliers. The lightener holes, in the casting and produced by these core points, are reamed out next with a special reamer attached to an offset hand grinder.

The castings are now taken through a double compartment shot blast chamber where a double nozzle spray of Number 19 shot is played on each casting for about two minutes to remove all adhering sand. The length of time required to thoroughly clean the shafts depends on the severity of the burning in effect of the metal.

After passing through the shot blast chamber, the castings pass on to the finish grinding department. Here, on double-head Stand Grinders the gates and riser break-off points, and all jagged edges and fins on the castings are ground smooth.

The crankshafts then pass on to the furnaces, where the heat treatment of the crankshafts is carried out in two units. In the first unit, a gas-fired furnace, the annealing treatment is carried out, and in the second unit, electrically heated, the normalizing treatment is effected.

After cooling, the crankshafts are placed on the cleaning conveyor again and sent back through the shot blast to remove all the scale formed in the heat treatment. After cleaning is completed the shafts are piled and inspected for cracks, rough spots needing grinding, etc. When passed by the inspectors, the crankshafts are taken, as required, to the machine shop where they are machined down to the dimensions required as a finished part of the motor.

The advantages derived from the use of a cast alloy steel crankshaft rather than a forged steel shaft are three-fold.

In the first place, the cast crankshaft after machining is much lighter than the forged one. Of the metal poured, the recovery is approximately 58.4% castings and 41.6% sprue, gates and risers. Castings molded and poured in groups of 4 weigh 480 lb. Risers, runners and sprue weigh 200 lb. leaving a net weight of 70 lb. per casting. This is 12 lb. lighter than the steel forging was. In the machining processes only 9 lb. of metal are removed from the cast shaft as compared to 16 lb. taken off the forging.

Secondly, the costs of producing the cast crankshaft are lower than those of producing the forged shaft due to the fact that much of the material used in making up the charge is obtained from other parts of the plant and is mostly scrap. Also, the machining operations on the castings have been reduced from 62 to 50 which effect a further reduction in cost.

Thirdly, the cast crankshaft is much stronger in comparison to its weight and cross-section than is the forging. In the cast condition the steel is hard and brittle but after a suitable heat treatment becomes very tough and strong. Brinell reading of the castings before heat

treatment is 340 to 360. After heat treatment the reading on the average is about 300 but the hardness remains uniform across the entire cross section of the casting.

Tests on the physical properties of each casting include an impact test where a 50-lb. weight is dropped on the flange of the centre main bearing, and torque tests where the casting is subjected to a twisting pressure of 45,000 in.-lb. The first torque test is applied after the casting has been rough machined and the second, in the opposite direction, is applied to the finished crankshaft. Other physical properties are tested as shown in the following table.

Limits on Test Bar	Max.	Min.
Elastic Limit, lb. per sq. in.	93,500	91,000
Tensile Strength, lb. per sq. in. ...	108,000	107,000
Elongation, per cent.	2.00	1.50
Reduction in area, per cent.	2.50	2.00
Brinell	269	255
Transverse Breaking, lb.	9,565	9,330
Deflection, in.	0.430	0.420

The employment of, and method of producing the cast steel crankshafts for automobile engines has proven very satisfactory, as far as the Ford Motor Co. of Canada is concerned, as evidenced by the fact that they are at present engaged in doubling the size of the present foundry at a cost of approximately half a million dollars. A cast steel brake drum is being experimented with at present and as alloy castings of iron and steel are being investigated more and more in the last few years, a rapid advance in the use of alloy iron castings may be expected in the near future. The virtues possessed by these alloy cast irons consist of vibration damping effect, fatigue properties, freedom from notch effect, corrosion and heat resistance and resistance to thermal shock. These virtues, with respect to definite applications, have scarcely been touched upon, and within the next few years they will all have been established definitely in the higher alloy compositions.

Daylighting or Natural Illumination

Condensed from a thesis for the degree of B.A.Sc. in Civil Engineering, by P. W. Gooch.

Standards and Requirements

One of the most important problems arising in the design of an industrial or office building, or any other building intended for human use or occupation, is the provision of adequate illumination. The problem is important not only from the humanitarian, but also from the economic standpoint. Men working in a poorly illuminated building cannot do their best work. Eyestrain and fatigue are caused, with a resultant detrimental effect on the quality or quantity of the goods produced, or the work done, entailing an economic loss to the employer.

Inadequacy of natural illumination can, of course, be remedied by the use of electricity, but it is advisable, economically, to design a building for best utilization of daylight as a source of illumination.

Years of study and experiment have led to the establishment of certain minimum intensities of illumination as standard requirements for various types of buildings and for different working conditions. Intensity of illumination is measured in foot-candles; one foot-candle being the amount of light thrown on a surface one square foot in area held at a distance of one foot at all points from a standard candle. At present, 10 foot-candles is considered the minimum intensity required on the working plane for efficient work in a factory or office. It is probable that in the future this requirement will be raised to 20 foot-candles.

Outside a building on a clear summer's day the illumination may be as high as 10,000 f.c., without causing injury to the tissues of the eye, which can adjust itself to the intensity. Only a small fraction of the outside light can be utilized inside a building, but it is advisable to obtain as much as possible, because no maximum limit for good visibility within a building has been found. This statement does not apply to direct sunlight, which is attended by glare and is injurious to the eye. Also the intensity of illumination that can be used is governed by a need for uniformity; it is advisable that the ratio of the maximum to the minimum intensity should not be greater than 3 to 1.

Sky Brightness

In discussing the daylighting of buildings, it seems logical to begin with a consideration of the source of light, that is, brightness. As far as the illuminating engineer is concerned, sky brightness is dealt with in only a general way, average values only being considered. Ordinarily, windows in industrial or office buildings are not designed to transmit the direct rays of the sun without some form of protection

from glare, such as blinds, shutters, curtains or glare-reducing coatings, or they may be fitted with special glass to diffuse the light.

Quite recently, in connection with a study of natural illumination made by the U.S. Public Health Service on an experimental building near Washington, a large number of measurements of sky brightness were made and average values were obtained for the brightness of the clear sky for several months in the year. The measurements were made on clear days in the months of May, June, July, September, October and November between the hours of 8 a.m. and 4 p.m. The monthly averages were found to be 482, 535, 444, 285, 244 and 242 candlepower per sq. ft. A sky of brightness 1 c.p. per sq. ft. will give an illumination of 11 foot-candles on the surface of the earth. Curves drawn from the values obtained indicate a maximum average brightness near the summer solstice and a minimum near the winter solstice. In fact, for purposes of design, the sky brightness used is the average for the 21st of December, at 4 p.m., in the locality in which the building is to be constructed. For this purpose, curves have been made up for various parts of the United States and values may be interpolated from these for some parts of Canada, (Fig. 8).

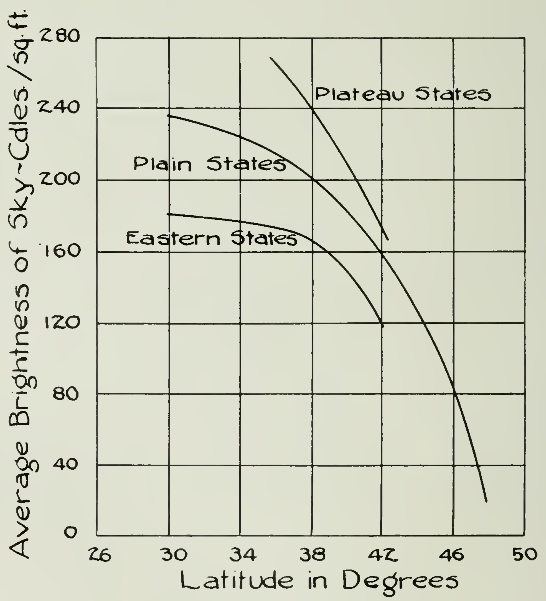


FIG 8
Variation of Average Brightness of the Whole Clear Sky with Latitude on Dec 21 at 4 P.M.

Values given are for the whole clear sky and allowance must be made for obstructions, such as buildings and trees, in the application of the curves.

Prediction of Daylight Illumination

In order that the fenestration, or window arrangement of a building, may be efficiently designed, it is necessary to have a means of predicting what illumination will be received from any given system of windows. The methods of prediction fall into two groups:

(a) Theoretical methods.

(b) Empirical methods.

The methods in class (a) involve the use of mathematical formulae. There are several sets in use, but the most recently developed, and perhaps the most accurate, is that derived by Higbie and Levin of Detroit. Specifically, these formulae are concerned with the prediction of illumination received at points on the working plane from a window of given uniform brightness.

The first case to be considered is that in which the window, or illuminating rectangle is horizontal and parallel to the working plane (Fig. 9). For convenience of calculation it is assumed that the point, P, on the working plane, at which the illumination is to be calculated, is under the edge of the window. This assumption is justified because the window may be divided up to meet the condition. The window is assumed to have a uniform diffusion brightness of b. E is an infinitesimal segment of the window. The illumination received at P from E is calculated and the expression obtained when integrated in both directions gives the total illumination received at P from the window. The quantities involved are shown in the figure.

E may be considered as a point source of light, hence, for the illumination received at P from E, we have:

$$d\,E\,p = \frac{(bdr.\ dh)}{D^2}\ .\ \cos\alpha\ .\quad \cos\alpha$$

$$= \frac{b\,c^2}{D^4}\ .\ dr.dh$$

Therefore, the illumination received from the whole window is:

$$E\,p = \int_{r=o}^{r=m}\int_{h=o}^{h=f}\frac{bc^2}{D^4}\ dr.dh$$

$$= bc^2\int_{r=o}^{r=m}\int_{h=o}^{h=f}\frac{dr\ .\ dh}{[c^2+r^2+(h-a)^2]^2}$$

$$\therefore E\,p = \frac{b}{2}\left[\frac{a}{(c^2+a^2)^{\frac{1}{2}}}\ .\ \tan^{-1}.\ \frac{m}{(c^2+a^2)^{\frac{1}{2}}} + \frac{m}{(c^2+m^2)^{\frac{1}{2}}}\ .\right.$$

$$\left.\frac{\tan^{-1} f(c^2+m^2)^{\frac{1}{2}}}{a^2+c^2+m^2-af} + \frac{f-a}{\{c^2+(f-a)^2\}^{\frac{1}{2}}}\ .\ \frac{\tan^{-1} m}{\sqrt{c^2+(a-f)^2}}\right]$$

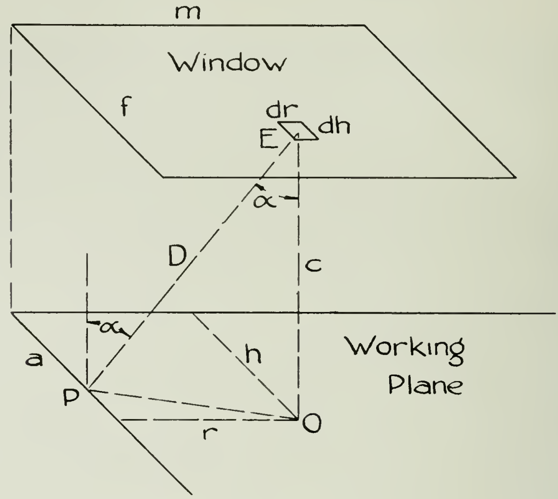


FIG. 9
Showing Case of Window Parallel
to Working Plane

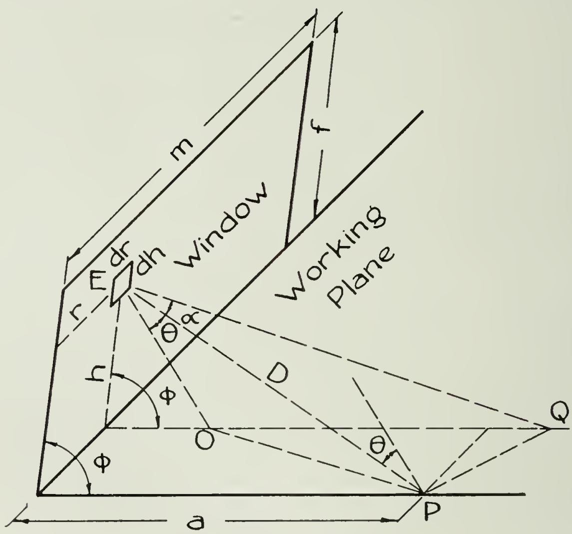


FIG. 10
Illustrating Case in which Plane of
Window slopes at an Angle Φ
to Working Plane

The formula is not so formidable as it might appear at first sight, and its use may be simplified by means of curves.

The next case to be considered is that in which the window slopes at an angle ϕ to the working plane, (Fig. 10). EQ is perpendicular to the window, and EO is perpendicular to the working plane. Again E may be considered a point source of light, so that the illumination received at P from E is:

$$d\,E\,p = \frac{b.\,dr.\,dh.\,\cos\alpha}{D^2}.\,\cos\theta$$

But $D = PE = (PO^2+OE^2)^{\frac{1}{2}} = \left[\,(h.\cos\phi - a)^2 + (h\sin\phi)^2\right]^{\frac{1}{2}}$

$\therefore D = (a^2+r^2 - 2ah\cos\phi + h^2)^{\frac{1}{2}}$

$$\cos\alpha = \frac{PE^2+EQ^2 - PQ^2}{2\,PE\,.\,EQ}$$

$$= \frac{D^2+h^2\tan^2\phi - \left[\left(\frac{h}{\cos\phi} - a\right)^2 + r^2\right]}{2\,D\,h \times \tan\phi}$$

$$= \frac{a\sin\phi}{D}$$

$$\cos\theta = \frac{E\,O}{D} = \frac{h\sin\phi}{D}.$$

$$\therefore\ d\,E\,p = \frac{b\,dr\,.\,dh}{D^2}\,.\,\frac{a\sin\phi}{D}\,.\,\frac{h\sin\phi}{D}$$

$$= \frac{ab\sin^2\phi\,h\,.\,dr\,.\,dh}{D^4}$$

Therefore, the total illumination received at P from the window is:

$$Ep = \int_{r=o}^{r=m}\int_{h=o}^{h=f} \frac{(h\,.\,dr\,.\,dh)\,ab\sin^2\phi}{[a^2+r^2 - 2\,ah\cos\phi + h^2]^{\frac{1}{2}}}$$

$$= \frac{b}{2}\Bigg[\tan^{-1}\frac{m}{a} + \frac{f\cos\phi - a}{(a^2+f^2 - 2\,af\cos\phi)^{\frac{1}{2}}} \times$$

$$\tan^{-1}\frac{m}{(a^2+f^2 - 2\,af\cos\phi)^{\frac{1}{2}}} + \frac{+m\cos\phi}{(a^2\sin^2\phi + m^2)^{\frac{1}{2}}} \times$$

$$\tan^{-1}\frac{f(a^2\sin^2\phi + m^2)^{\frac{1}{2}}}{(a^2+m^2 - af\cos\phi)}\Bigg]$$

If ϕ is equated to 90° in this expression, another formula is obtained for Ep, which is applicable to vertical windows. It is:

$$Ep = \frac{b}{2}\left[\tan^{-1}\frac{m}{a} - \frac{a}{(a^2+f^2)^{\frac{1}{2}}}\tan^{-1}\frac{m}{(a^2+f^2)^{\frac{1}{2}}}\right]$$

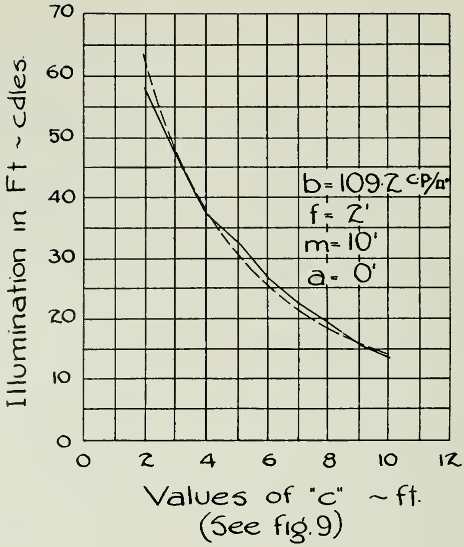


FIG. 11
Comparative Results for Illumination under Horizontal Window
----- Calculated ——— Experimental

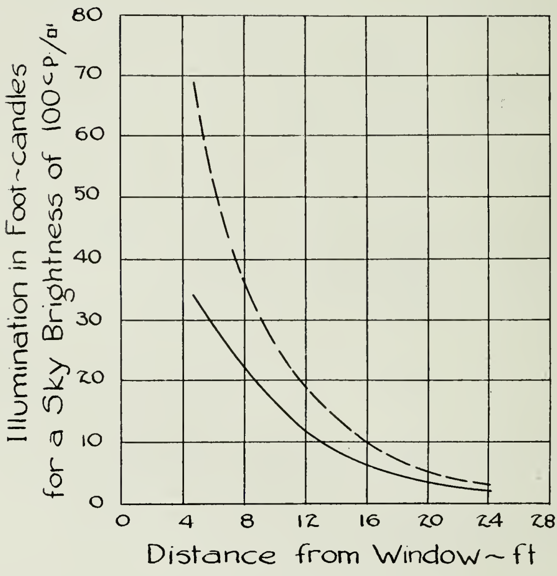


FIG. 12
Comparing Experimental & Calculated Values for Illumination along Center Line of Room when Walls & Ceiling are Black
Solid Line ~ Experimental. Dotted Line ~ Calculated

These formulae were checked both theoretically and experimentally by the originators, and by others, and the results of the checks indicated the accuracy of the formulae. For instance, measurements of illumination received from a special horizontal window were made in the laboratory with a photometer, and were compared with values calculated by use of the formula developed above. The curves in fig. 11 show how closely the results corresponded.

The empirical methods of predicting natural illumination on the working plane involve the use of tables made up from the results of experiment. One set of such tables was made up by Knowles, Ives and Thompson of the U.S. Public Health Service, working with the experimental building mentioned above under "Sky Brightness." On the roof of the building, they set up apparatus for measuring the brightness of the sky, consisting of a pair of photronic cells, with a recording galvanometer. Inside the building, measurements of illumination were made by means of a photoelectric cell connected through an amplifying system to a recording potentiometer. The apparatus was mounted on a little wagon and could be easily moved about the room. The windows were facing northward, and were equipped with shutters so that their size and shape could be varied.

Thousands of measurements of illumination were made at stations distributed uniformly over the room for different shapes and sizes of window area, and simultaneously the brightness of the sky was measured. The results were averaged and reduced to a basis of illumination received per 100 c.p. per sq. ft. of sky brightness. The first set of readings were made with walls and ceiling mat white, the next with walls mat white and ceiling mat black, and the last with walls and ceiling mat black. Six tables were made up, giving the illumination in foot-candles received at 25 different stations in the room, for a sky brightness of 100 c.p. per sq. ft., not only from the windows but also from the walls and ceiling by reflection. The tables are as follows:

(1) Illumination received with mat white walls and ceiling.
(2) Illumination received with mat white walls and black ceiling.
(3) Illumination received with black walls and ceiling.
(4) Illumination by reflection from white walls and ceiling.
(5) Illumination by reflection from white walls alone.
(6) Illumination by reflection from white ceiling alone.

The values in the latter three tables are obtained by subtraction of corresponding values in the first three. These tables afford a simple and quick means of predicting daylight illumination received within rooms of limited size. The direct component of the illumination will be proportionate to the ratio of the existing sky brightness to 100. The reflected component will be proportionate to the ratio of the reflection factor of the material to be used on the walls and ceiling, to that of mat white paint which is about 0.82.

In figure 12 are drawn curves obtained by plotting values from the tables, and values obtained by calculation from the Higbie-Levin formula for vertical windows. There is an apparent discrepancy of about 40%, but when allowance is made for obstruction to transmission of light by the windows due to muntins, mullions, wind bracing, reflection, absorption and dirt, the results are found to correspond quite closely.

The Transmission of Light by Glass

(a) *Transmission Properties of Glass Itself*

Window glass absorbs and reflects a considerable portion of the light falling on it, and consequently there is a reduction in the intensity of light passing through a window that is indicated by the transmission factor of the glass. The transmission factor will depend on the nature of the incident light, the thickness of the glass, the method of manufacture and the intrinsic properties of the glass, so that before accurate predictions of daylighting can be made, it is necessary to study the glass to be used. In the following discussion, clean glass is considered. The effects of dirt are studied in the next section.

The transmission factor of window glass will vary greatly with the angle of incidence of the impinging light. This is due to the fact that the percentage of light reflected from the surface of the glass increases rapidly with the angle of incidence. The percentage of light absorbed also increases, but to a lesser degree. For ordinary clear, smooth glass the amount of reflection is 8% for normal incidence, 12% for an angle of incidence of 50° and 90% for an angle of incidence of 87°.

With normally impinging light, the transmission factors of various types of glass are: 92% for clear smooth glass, 83% for rough rolled glass, 63% for prismatic glass.

When the incident light is perfectly diffuse, clear smooth glass is found to transmit about 84%, and other types of colourless glass, 76 to 53%. There may be a considerable increase in these values if the glass is thin.

When sheet glasses have one smooth and one rough side, the value of the transmission factor, when the smooth side is facing out, may be different from the value when the smooth side faces inward. The ratio of the two values may be greater or less than one, depending on the nature of the incident light and the intrinsic properties of the glass. Results of tests show that when rough-and-smooth glass has flutes, ribs, or prisms, they should run vertically for best transmission when the rough side faces inward; but if the rough side faces outward, it is usually better to run them horizontally.

The nature of the glass used will also affect the distribution of the light within a building, especially if the source is sunlight. Horizontally-ribbed glass gives the best distribution, throwing more light to the

back of the room where it is most needed. All ordinary glasses decrease the minimum or critical illumination considerably, by amounts ranging from 30 to 70%. But many increase the uniformity so as to offset this defect.

(b) *Dirt on Window Glass*

All of the data given in the previous section was for clean glass. However, glass in industrial windows is seldom kept clean for any length of time, so that is desirable to study the manner in which dirt accumulates on windows, and the effect that it has on the light transmitting properties of the glass.

The chief factor influencing the rate of accumulation of dirt on a window, is the degree of slope of that window from the vertical. In figure 13 are shown curves indicating the rate of accumulation of dirt on windows at four different slopes. It is apparent that as the angle of slope with the vertical becomes greater the rate of accumulation also becomes greater, but in a lesser proportion.

There are two main causes of a higher rate of accumulation with a larger horizontal projection of window area. In the first place, most particles of dirt in the atmosphere are tending to move toward the earth under the influence of gravity, so that a window which presents a large area for them to fall on will receive a large deposition. Inside a building, the air, often laden with dirt from smoke or chemical fumes,

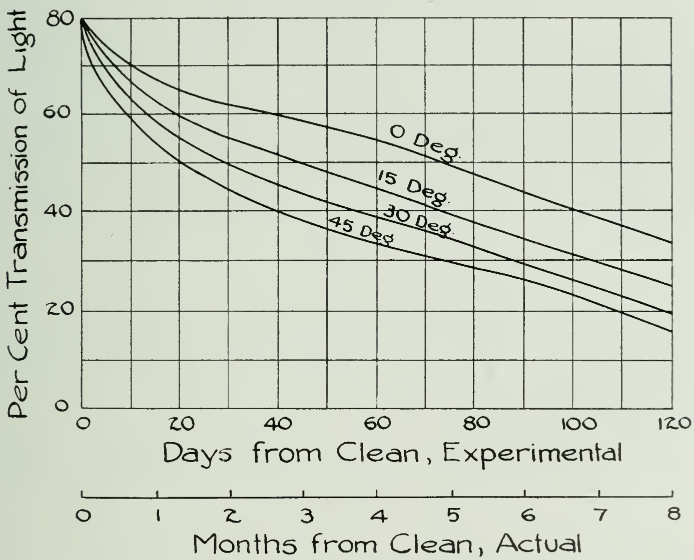


FIG. 13
Showing Decrease of Percent Transmission of Available Light with Time due to Dirt

tends to rise in convection currents, and if the windows above are sloping there will be a good deal of dirt deposited when the currents of air strike against them.

It will be noted that in Figure 13 no mention is made of the type of glass used in the tests. This is because it has been found that the nature of the glass used in a window does not affect greatly the rate of deposition of dirt. Rough glass does not accumulate dirt more readily than smooth glass. However, rough glass is, of course, more difficult to clean, which is one disadvantage of its use.

Another fact worth mentioning in this connection, is that under normal conditions, about 75% of the dirt on a factory window is on the inside, and the remaining 25% on the outside. The chief reason, of course, is that rain helps to keep the outside clean. The fact is unfortunate, because windows are usually more easily, or, at least more conveniently cleaned on the outside, especially if they slope.

Industrial windows are seldom washed, and, more often than not, it is in the spring when they are washed. But actually, if windows are to be washed only once a year, it is preferable that this should be done in the fall, so that they will be most efficient in the darker months of the year when efficiency is most needed.

Design of Fenestration

In the design of office buildings or factories, the adequacy of the fenestration, or window system provided is often of necessity, given only secondary consideration. Considerations of general economy, strength, and architectural soundness, must frequently take precedence. However, it is convenient for the engineer or architect to have a knowledge of the basic principles governing the design of daylighting facilities. This, of course, enables him to make the best feasible provision for such facilities in the design of a building.

Several general rules of design are illustrated in the examples that follow, dealing with both sidewall and roof fenestration.

(a) *Sidewall Fenestration*

First consider a building with windows in one sidewall only, as shown in Figure 14. The curve drawn shows the variation in intensity of illumination provided on the working plane, with a sky brightness of 250 c.p. per sq. ft. (i.e. corresponding to an overcast sky and clean windows). The curve shows that the intensity falls below the desirable minimum of 10 f.c. at about 21 ft. back from the window. This exemplifies the general rule that a clean window gives adequate illumination to a distance within the building of three times its height above the working plane.

With 6 months dirt on the windows, the intensity falls to 10 at 15 ft. from the window. That is, a dirty window gives adequate illumination to a distance of only twice its height within the room.

Next, consider the same building with windows on both sides as in Figure 15. The illumination curve for this condition has ordinates

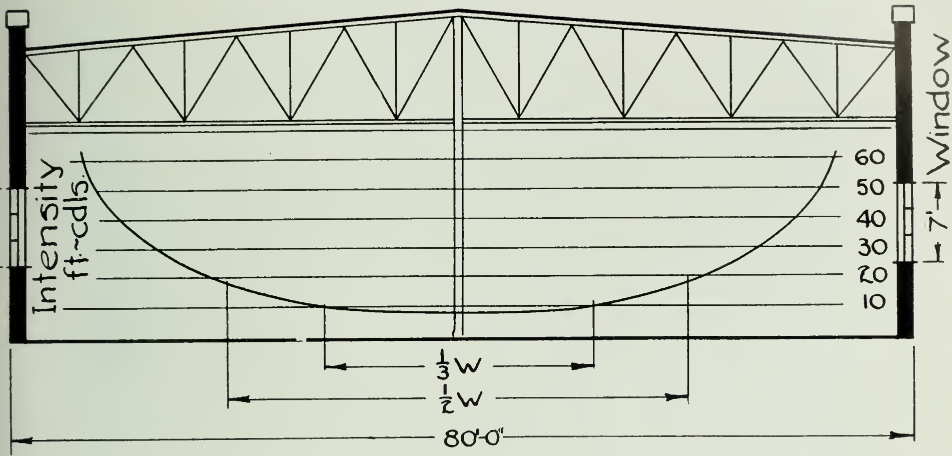


Fig 15

Showing Variation of Illumination Intensity with Windows in both Sidewalls

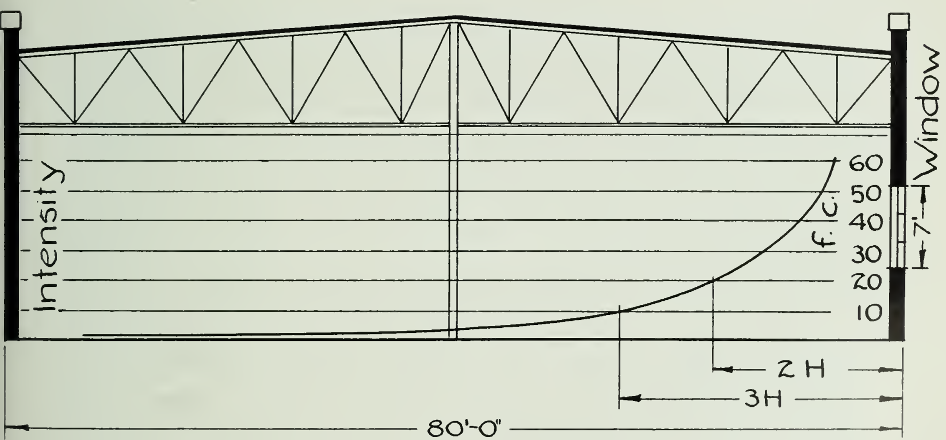


Fig. 14

Showing Variation of Intensity of Illumination with Windows in One Sidewall Only

which are the sum of those for two curves such as shown in Figure 14, drawn, one from each side of the building. The curve shows that, for clean windows, about 30 ft. of width of the building are inadequately lighted. When correction is made for dirt on the windows, over half of the building is below the minimum.

Let the window height be increased to 12 ft. It is then found that, after correction is made for dirty windows, 20 ft. of the building are inadequately lighted. However the increases in intensity of illumination obtained are as follows: 35% at 5 ft. back from window; 75% at 15 ft. back; 120% at 30 ft., and 125% at the center.

These figures indicate that it is the upper part of the window that throws the most light to the back of the room, as would be expected. It is also indicated that the minimum illumination increases with the height of the windows but in greater proportion. The uniformity of the illumination is ameliorated, because the minimum intensity increases more rapidly than the maximum.

In the only one of the designs considered above, which was satisfactory, the window area was

$$\frac{12+12}{80} \times 100 = 30\%$$

of the floor area. This illustrates another rule, which is that, for adequate illumination the window area should be at least 30% of the floor area.

(b) *Roof Fenestration*

Even in the best of the designs for sidewall fenestration considered in the previous section, the intensity of illumination in the middle of the building was near the minimum, in spite of the large window area required. Thus, it seems evident that some form of roof fenestration is desirable to assist in lighting the middle portion of the building.

If, to the building as originally designed (sidewall windows 7 ft. high) is added a monitor with windows 3′-6″ high, the minimum intensity is increased to 16 f.c. When allowance is made for reduction due to dirt, about 28% of the building is below the minimum. However the 50% increase in window area has doubled the minimum intensity.

Let the height of the monitor windows be increased to 7 ft., giving a design as shown in figure 16. The curve shows a maximum of 72 f.c. and a minimum of 30 f.c. This design is thus quite satisfactory, providing good uniformity, within the 3 to 1 ratio of maximum to minimum, and a high minimum. It may be concluded from these results, that in a long span building, less window area is required for adequate daylighting when a monitor is used, and the uniformity is better.

The efficiency of a monitor is determined to a certain extent by its width. When the windows are vertical, the width of the monitor should be about twice the height of the windows, in order that no light cut off may occur. When the monitor windows are sloping,

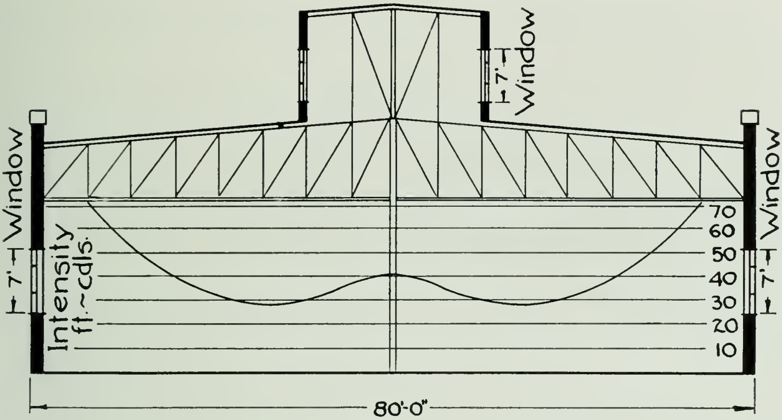


Fig. 16

Showing Distribution of Intensity of Illumination in a Building with Windows in Both Sidewalls & Both Sides of Monitor

it is desirable to have the span of the monitor equal to half the space of the building or bay to be lighted, in order to obtain best uniformity. Sloping windows in a monitor are found to provide better lighting than vertical windows unless 6 months dirt, or more, accumulates. Then the reverse is found to be true.

Another form of fenestration commonly used for roof illumination is the skylight. The skylight has several features which make its use undesirable in many cases where monitors may be used. One objection to skylights is that they decrease in efficiency due to dirt deposition more rapidly on account of the flat slope of the glass. Also they are a good deal more difficult to wash, particularly on the under side where most of the dirt collects. Usually, too, a larger glass area is required for skylights. Also, water from condensation on or leakage through a skylight may be troublesome, dropping on the workmen or goods below. Finally, it might be mentioned that the monitor is a much more efficient means for natural ventilation than is the skylight.

Sometimes in buildings of large span, sawtooth roof construction is used with windows on one side of the sawteeth. These may be faced north to receive skylight without sunlight or they may be faced south to receive light from the brightest part of the sky in the dark winter months. In the latter case a glare reducing coating is usually required for protection from the direct sunlight in the summer. In the design of a sawtooth roof the same general principles are followed as in the design of a monitor roof. The span of the teeth should not be so great as to give poor uniformity, nor so small as to cut off some of the light. One feature of the sawtooth roof that is objectionable in northern latitudes is the fact that snow may collect in the troughs and cause leakage when it melts.

The sawtooth roof is, on the whole, less commonly used than the monitor type.

Conclusions

The laws and principles of natural illumination which govern the design of fenestration systems for office or factory buildings, are, by nature, of a very general character. Because of the variability of the natural phenomena on which they are based, any rules set down must be flexible, and may find embodiment in a large variety of designs, all equally correct.

However, there are certain general rules that may be applied to the design of a window system for any building. They may be stated as follows:

(a) The windows should be higher from the floor as they approach the center longitudinal axis or axes. (It is often desirable on account of the width of the building or other conditions to have more than one longitudinal axis).

(b) There should be equal window areas perpendicular and parallel to the center axis or axes.

(c) The roof surfaces should be relatively flat.

The advantages to be gained by the use of a design based on the rules outlined above, are as follows:

(1) There will be a maximum possibility for uniformly distributed light.

(2) Shadows will be eliminated as far as possible.

(3) There will be a possibility of varying the windows and using any height consistent with the desired intensity of light.

(4) The outside of the windows may be washed from the roof and provision may conveniently be made for washing the inside.

(5) Glare reducing coatings may easily be applied in summertime and may be removed with equal ease in winter.

(6) Flat roof surfaces give the least obstruction possible to direct light and consequently, there is less need for dependence on outside reflecting surfaces for light.

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Engineering Research and Progress

Address to the Engineering Society, University of Toronto, Oct. 29, 1935, by E. A. Allcut, Professor of Mechanical Engineering, University of Toronto.

The meaning attached to the word "progress" varies somewhat in different circumstances, but here it is used to denote the changes that have taken place in the world within the last few centuries; from barbarism or a chaotic state, to civilisation or an ordered state of society. This kind of progress has affected everybody, as it has altered entirely the conditions under which men live, work and rest. H. G. Wells* has described, under the following heads, the kinds of change which have occurred:—

The conquest of *substances,* which has made available for mankind new materials in larger quantities and more diverse forms.

The conquest of *power,* which is essentially the substitution of mechanical slaves for human and animal ones.

The conquest of *distance,* which has increased man's effective radius of activity and communication.

The conquest of *hunger,* which has made it possible to feed larger numbers by more extensive and intensive cultivation, by better and safer storage and by more rapid transportation.

The conquest of *climate,* which has provided better protection from the rigours of the weather for mankind, both when at rest and in motion.

A study of the details of these various conquests indicates that all of them are due largely to the researches and discoveries of engineers.

Research is an endeavour to discover facts by scientific study or by a course of critical investigation. The early academies (about 1590-1666) were almost entirely individualistic in their activities, and most of their meetings served mainly to gratify the curiosity of the members. References in Pepy's diary to the meetings of the Royal Society indicate this fact rather clearly. There was apparently no great amount of co-operation between the scientists of those days, principally on account of transportation difficulties and the scarcity and high cost of books. The changes that have taken place since then, have been due largely to the Industrial Revolution (1770-1800) and are thus summarised by Wells*:

"A man like Cavendish, the great chemist, or the Abbé Mendel, could work on his own resources and could leave notes and observations behind him to lie undeveloped and disregarded for a long time; but now we think a great deal more in *each other's minds* than we did."

With a greater diffusion of knowledge and information and an ever-widening mental horizon, step-by-step methods have taken the place of

*"Work, Wealth and Happiness of Mankind," Vol. I

flashes of intuition, and team work or group thinking has been substituted for individual cogitation.

A further consequence of these changes was that science "ceased to be a recreation and became a pursuit." The early engineers were frequently men of little or no education; some of them scarcely knew how to write but, first the military and then the civil engineers bridged the gap between the pure or speculative scientists and the workers, and provided those applications of scientific principles which have created a new world.

For the purpose of this lecture, the motives that inspire research have been divided into five classes. This division is quite arbitrary and the various sections overlap considerably, but it has been adopted solely as a matter of convenience and to facilitate illustration.

With this proviso, the various reasons for research are:—

(1) *To test or confirm a theory or speculation.* Good examples of this class are the researches and discoveries that have arisen from Sadi Carnot's "Reflections on the Motive Power of Heat" (1824). These have led (among other things) to the Diesel or Compression Ignition Engine, to the use of bleeding and progressive feed water heating in steam power plants, to the successful fixation of nitrogen from the atmosphere, to the synthetic production of ammonia and many other important practical results.

Parsons' researches on the steam turbine and the equilibrium of shafts rotating at high speeds may be reasonably included in this group, and possibly also Claude's work in connection with the production of power on a practical scale from differences in temperature between the surfaces and depths of tropical seas.

The problem of transmitting messages through submarine cables led Kelvin to deduce from calculations the fact that the speed of transmission in words per minute was inversely proportional to the total resistance of the conductor. This led eventually to the specification and use of high conductivity copper for electric cables.

(2) *To produce something new, improved or more efficient, or to find a means of supplementing existing natural resources.* An outstanding example in this class is the production of oils from coal by hydrogenation at high pressures (250 atmospheres) and temperatures (850° F.). This is being applied on a large scale in Germany where one plant produces 300,000 tons of motor fuel per annum from brown coal or lignite. Great Britain has been working on this problem since 1927 and has recently started the first unit of a plant which is expected to produce 150,000 tons of motor fuel per annum. The total coal consumption is expected to be about 600,000 tons per annum* and the effect of it will be to stimulate the coal industry and to replace supplies of liquid fuel which now have to be imported.

*Engineering, Oct. 25, 1935

The production and use of alcohol as a motor fuel, which is compulsory in some countries and optional in others, also comes within this category.

The correct working of tungsten, to produce a suitable metallic filament for electric lamps, was the result of long and patient research, as also was the production of silicon steels having low hysteresis losses for electrical machinery.

(3) *To overcome a difficulty or improve a process.* One of the principal difficulties encountered in the attempt to improve the performance of gasoline engines is, that when the compression ratio is increased, detonation or combustion knock is liable to result, and this seriously affects the performance and life of the engines. A long co-operative research in different countries has led to changes in cylinder design, standardisation of methods of testing fuels and to the use of dopes such as tetra-ethyl lead, which have made the high compression engine practicable for general use.

The high speed compression-ignition (Diesel) engine has also been made possible by the study of oil sprays in very dense air, through the agency of a research apparatus that will take about 2000 photographs a second with exposures of about one millionth of a second.* This enables the formation and collapse of the oil jet, under different working conditions, to be investigated in great detail.

During the Great War, considerable trouble was caused by the failure of reduction gears, which were used in aircraft engines to drive the propellers at reduced speeds. A detailed investigation showed that considerable differences of strength existed in different teeth on the same wheel. Such weaknesses were finally traced to the method of drop forging, which was changed with beneficial results. This process is now in general use for making automobile gears and other small wheels.

Inspection methods have been made more comprehensive and improved performances have resulted from the application of X-ray examination to castings, forgings and assemblies, in cases where the internal conditions are unknown. Researches on the creep of steel at high temperatures and the erosion of blades by wet steam have produced great improvements in steam turbine performance.

(4) *To explain discrepancies or differences between actual and expected phenomena.* Intelligence tests made in connection with a sales job gave results which did not agree with experience. An investigation showed that the job was of a routine nature, so that the good men would not stay long enough to get a record commensurate with their ability. Mediocre men, on the other hand, stayed with the job and got the best sales records in consequence of their longer experiences. Thus, for some purposes there is an upper as well as a lower limit of intelligence which must be known, so that a satisfactory result may be obtained.

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*National Advisory Committee for Aeronautics Report No. 274

Some trouble was experienced in Toronto when a new type of heating radiator was introduced. After many tests had been made, it was found that there were considerable differences between their heat transmissions when using water and steam, respectively, and this fact was the cause of the difficulties encountered. Eventually, the problem was solved by modifying the form of the housings and increasing the velocity of the water through the radiators.

The power curve of a gasoline engine differed from that expected when mixtures of varying richness were used. Investigation showed that this was due to the bad distribution of fuel to the various cylinders and was caused by the design of the carburettor and intake manifold.

Analyses of the exhaust gas from an oil engine differed materially from those expected. A research was undertaken to find out the reason and it was proved that the sample of gas taken from the exhaust pipe of a single cylinder engine could be, and in many cases was, entirely unrepresentative. This was an important factor in the thermal calculations which were based on those analyses.

The observed discharges from steam nozzles, in many cases, were higher than those deducted from calculations. This led to the discovery of "supersaturation" which is a very important principle in the expansion of steam.

Microscopic examination of the structures of metals and alloys has provided a convenient means of investigating failures and preventing their re-occurrence.

(5) *Accidental discoveries or by-products of other researches.* This group has something in common with (4) and some examples have been given under the other headings, but the following may be of interest.

Electric welding was discovered accidentally by Elihu Thomson, who discharged a large Leyden jar through the secondary winding of an induction coil. The primary terminals were lightly in contact with each other and, after the experiment, these were found to be welded together.

Radioactivity and the peculiar properties of uranium compounds were found accidentally by Becquerel while studying phosphoresence. This led eventually to the isolation of radium.

The discovery of manganese steel should probably be included in this category as, for a long time, it was considered that if more than 3½ per cent. of manganese were used, the steel produced would be too hard and brittle for practical use. Hadfield tried the effect of adding larger quantities and found that with 13 per cent. of manganese, properly heat treated, a strong and very tough steel was produced. It was expected that this new steel might be used or adapted for cutting purposes, but it was finally discovered that its principal usefulness lay in its high resistance to abrasion. Thus, two unexpected results were obtained from this research.

In conclusion, a few remarks on unsuccessful researches may be timely. We hear so much about the results and consequences of successful research, that we do not realize the fact that many researches are unproductive. Sir Charles Parsons, who made so great a success of the steam turbine, spent about $150,000 trying to make diamonds, without success. When he broke his apparatus, he said,* "Well, we have the satisfaction of having *bust* it!" He also exploded the legend that the Egyptians possessed the secret of hardening bronze, by testing some ancient bronze chisels and finding that they had nothing beyond the ordinary degree of hardness that can be obtained by cold working.

When the research worker, after long and patient toil, arrives at a negative or inconclusive result, he is liable to be disheartened, but such occasions are bound to occur to systematic workers in any field. Sometimes negative results are of value because they reveal the lack of potentialities in fields hitherto unexplored.

Many papers and articles have been written on the meaning of the Pyramids of Egypt, and Kipling made the following pertinent comment:—

> "Who shall doubt the secret hid
> Under Cheops pyramid
> Is, that the contractor did
> Cheops out of several millions."

In other words—perhaps there *is* no secret! In that case, it is just as well to be *sure* that there is none.

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*Scientific Papers and Addresses of Sir Charles Parsons (Cambridge University Press 1934)

Present Status and Future Trends in Automobile Engineering

Abstract of an address delivered before the University of Toronto Engineering Society, December, 1935, by W. J. Davidson, Technical Director, General Motors Corporation, Detroit.

In observing these annual displays of new model motor cars, the significant thing to note is the trend in both appearance and mechanical design. In the 1936 cars, the appearance trend is in the same direction as in 1934 and 1935; the narrow radiator and streamlined appearance of fleetness have definitely affected the style position of the whole industry. The 1936 chassis also are a continuation, with refinements, of the satisfactory 1935 designs.

If you judge the cars merely from their outward appearance, you may wonder what the engineers have been doing with their time. Remember, however, that it is a good engineering policy never to make a change simply for the sake of changing, but to change only to improve—and it often requires a lot more painstaking work to refine something already fundamentally good than it does to take a radically new position.

Engineers are frequently asked why various makes of cars use different mechanical constructions. Although different cars use different constructions, they are built upon definite engineering principles which each company carries out by methods it believes to fit best into its own economic and practical set-up.

Research laboratories play an important part in the formulation of these principles; ours have been responsible for many of the outstanding advancements now common to all automobiles. Here we have unmatched facilities manned by the best personnel in the industry, under a management ready to spend money in order that the future mechanical position of the Corporation may be amply protected. "Research is simply a scientific method of finding out what you are going to do when you can't do what you are now doing any longer." One great advantage of a Research Laboratory is that it is unhampered by the daily difficulties with which each Division Engineering Department has to deal, so that the research personnel have free and open minds, to look ahead and consider future development.

Our engineers are now confronted with a difficult situation, which may persist for some time. We seem to be in an era of rising material prices. During the so-called "Roaring Twenties," predepression years, we were able to manufacture bigger and better motor cars each year, at the same or reduced prices, due to the influence of increasing volume and the fact that our manufacturing technique was improving rapidly through the benefits of large quantities. In the depression period the

trend of material prices was generally downward and therefore we were able to carry on the same policy. The cost of the motor car is, in the main, predicated upon the amount and kind of material used in it. Prices are rising and we will have to use more brains and less material. "Automobiles are made of steel and brains—the more brains the less steel." Our engineers are striving hard to do this and at the same time to maintain a reputation for dependability, durability and safety.

As an illustration of the application of principle, we might discuss the subject of brakes, in view of the fact that our 1936 cars have brakes which are actuated by hydraulic pressure. To get down to fundamentals, any brake consists of a device for slowing down a motor car at any rate desired by the operator. Now the way to slow it down is by pressing a shoe faced with a friction lining against a drum made of suitable material. The result is that the harder you press, the more friction you develop and the more rapidly you stop.

The reason that we have developed hydraulic brakes is not because mechanical brakes are not a sound feature, but because of late years mechanical brakes have lagged behind—as far as development was concerned—the other features of our cars, such as top speed, acceleration, etc. Therefore, due to the fact that the technique of operating brakes by hydraulic means had improved greatly, we adopted them.

Hydraulic means of transmitting pressure has an important advantage, in that pressure is distributed equally in all directions, and further, this means of pressing the shoe against the drum requires less effort to operate than can be built into a mechanical system without undue cost. We adopted hydraulic brakes only after we had been able to develop methods of doing so which we consider entirely fool-proof and satisfactory.

Automotive engineers, however, do not confine their work to determining principles and applying them. They must concern themselves with the ultimate test of motor car value; that is, how does it operate on the road in the hands of an owner? The General Motors Proving Ground is a great outdoor laboratory whose specific job is to answer that question. There we have a definite set of tests for our own cars, and for competitive makes as well, and there each division of the corporation maintains a staff of experts for the road testing and development of future production models.

Valuable data have been gathered at the Proving Ground, affording us a means of determining the over-all value of a car, and of measuring progress. For example, consider price per pound. In 1926, a Chevrolet Master four-door sedan cost more than 29 cents a pound; it had a maximum speed of slightly more than 45 m.p.h. and at 40 m.p.h. ran 15½ miles to a gallon of gasoline. Today, the 1936 Chevrolet Master costs about 21 cents a pound, will do about 80 m.p.h. and at 40 m.p.h. runs 20 miles to the gallon of gasoline. These figures reveal tremendous progress, but furthermore, the 1936 model is a marvel of smoothness, easy riding, easy steering, easy braking, and above all, safety compared with the 1926 model.

Another subject that has caused much discussion in the last few years is body construction. One of the principal points at issue has been the amount of wood used in a body structure. (Incidentally, all bodies up to now contain some wood or similar substance.) We hear that one manufacturer uses virtually no wood, while another announces to the world that he has added a substantial amount of wood, and each asserts that improvement has resulted. Actually, the amount of wood used in a body is inconsequential; the main thing sought is structural strength. Our use of a solid steel top, plus a steel floor and steel sides, has greatly enhanced structural strength. Previously, bodies could be likened to a box lacking top and bottom, a structure that is quite flexible; when you fasten the top and the bottom to the box, it becomes rigid. Our steel roof and steel floor similarly effect rigidity of the body structure.

Because the automobile is a leading example of mass production, I am frequently asked how good work can be attained at the high speed of the assembly lines. Now, speed is not in itself an element of mass production, but a by-product that results from high quality precision work in the machine shops. Thus, the speed of assembly is a guarantee of the high order of machine work; the parts and units must be practically wholly interchangeable, made exactly to standards, to permit fast assembly.

. . . . I should like to touch briefly on the question of men vs. machines. It is often proclaimed, by those who would stifle progress, that modern machinery causes unemployment, but this assertion does not accord with the facts. Mr. E. E. Loomis, president of the Lehigh Valley railroad, put it this way:

> "Alleged displacement of manual labor by the machine is discredited by recorded facts, which prove that the additional avenues opened up by the machine, and the advancement generally that can be attributed to it, lead to many more jobs than existed formerly."

. . . . Nowadays, no discussion of automotive engineering is regarded as complete unless it touches on highway safety. Let me, therefore, quote from remarks made by Mr. W. S. Knudsen, executive vice-president of General Motors, before the congress of the National Safety Council:

> "Let us go at this problem of highway safety with the same common sense and good judgment that have brought about improved safety in manufacturing. Even if we were not actuated by humanitarian reasons, the automobile industry would be actuated by the principle of self-preservation, because there is nothing more certain than adverse public reaction to a motor car inherently unsafe.
>
> We in General Motors have given a great deal of thought to the causes of automobile accidents. Yet it is impossible to say how many automobile accidents are due to any particular cause, since to determine the causes requires much more careful investigation than

is usually made. Further, most automobile accidents are the result of a combination of causes, which further complicates the situation. We find that there are four factors confronting the safe operation of an automobile; these are the car, the driver, the highway, and the other fellow. We believe that in only a small percentage of accidents is the car itself to blame. That is only natural, for we have spent large sums in finding, perfecting, and making available to the public, devices for greater safety in the operation of motor cars. Such developments include self-starters, closed bodies with steel tops, four-wheel brakes, synchro-mesh transmissions, independently sprung wheels, multibeam headlights, and adequate warning signals.

I might mention an example of what can be done where you have a combination of discipline and skill. At our Proving Ground, we have operated more than 56,000,000 car miles, mostly at very high speed, and we have had but one fatal accident—and this one accident occurred in a type of test where the risk was great, undertaken to insure safer cars for the general public."

To sum up this discussion: We all know that, generally speaking, in order to get along in life, we have to compromise on a great many things—and engineering is no exception to this fundamental rule. Any engineer can produce a car with extraordinary speed, acceleration, or economy, but to do this he must sacrifice other desirable things. Therefore, the ideal motor car is one which offers the best balance of all the desirable factors which make up a unit of individual transportation. We pay great attention to each individual factor, but concentrate our maximum attention on attaining the best combination of these factors, which is, after all, the result whereby the owner finally appraises our efforts.

I told you this once before, and I want to repeat it more forcibly than ever: The ground floor is always here. The opportunities for engineers, when we get our economic troubles a little bit in the clear—and we seem to be making considerable progress right now—will be greater than ever.

Above all, remember the definition of engineering, which is that it is nothing but "applied horse sense." Use your brain to *think* and your mind to *reason* with.

International Side Lights

Article by T. R. Loudon, Professor of Applied Mechanics, adapted from an address to the University of Toronto Engineering Society, January 30th, 1936

In placing some observations on international matters before the readers of "Transactions," may I first give you my outlook on these questions so that we may understand one another.

I am of the opinion that we hardly realize in Canada that the people of European nations do not think as we do. Their mental processes are quite different. The same question asked a Frenchman, German, Russian and Englishman is likely to produce four different answers. This is due, I maintain, largely to the philosophical development of the people. The philosophy under which large portions of any nation live determines the national attitude to life. And we must realize this if we are to make progress in the realm of international understanding.

I am also of the opinion that we in Canada are rather fond of hearing the worst about other nations. It is a negative attitude which in the end defeats progress. I do not suppose that any one will contradict me when I say that if we wish to get along with individuals, we seek common grounds of interest; and then if there are characteristics in each other to correct, we work outward from the common ground of interest toward this correction. If this is so with individuals, it is so with nations; and as we seek positive qualities in other nations, so fast and no faster will we make progress in correcting objectional qualities in our own nation and other nations.

I heard a story this summer which illustrates the final dilemma in which one is likely to land if only a negative attitude is maintained.

A certain man who was lecturing on South Africa concluded by saying that what was wrong with South Africa was that it needed a better water distribution system throughout the country and a very much better type of settler. Then, as he paused to let this sink into the minds of his audience, a little man at the back called out: "Why! that's all that is wrong with hell!"

I would also point out that this negative attitude of people leaves them open to a large amount of misleading propaganda. There are people sufficiently alert to seize the opportunity to see that we get only one side of international questions if we are negatively minded.

Every one of course is interested in hearing what is really going on in Germany. First, may I emphasize the fact that the Germans are intensely anxious to retain British friendship. They recognize that in spite of our disagreement with many things they do, that they will receive a measure of fair play from England which is not to be obtained elsewhere. As a result, there is a policy of encouraging Britishers to

travel in Germany; and certainly thousands have done so during the last two summers. It has been made just as easy to travel in Germany as elsewhere; there are no obstacles. One comes and goes as one pleases, and receives the greatest of courtesy.

A traveller in Berlin is first impressed by the large number of soldiers in evidence; regular soldiers, Labour Corps men and "Brown Shirts." What are they all doing?

The Labour Corps is for young men of 18 years or over who are not earmarked for a profession or a University. They go into labour camps where they are under a certain amount of discipline and they work on national construction such as roads, etc. What impressed me was the good physical and mental condition of these young men; and the reason is to be found in the unselfish objective before them. They believe they are working for the upbuilding of their country and they worship Hitler who has enthused them with this objective.

Make no mistake about this; the young men of the country worship Hitler and are behind him heart and soul.

Physical training is one of the German national policies. The result is certainly good. The young men are a splendid looking lot physically. There is very little doubt that Germany physically is back on her feet.

As to what the military training is directed toward, I would point out that Germans say they are the defense against the spread of the communist experiment. They certainly have some idea of military advance eastward or south-eastward when the right time comes; and anyone who is the ally of Russia will be Germany's enemy. This is axiomatic and is the basis of the present trouble on the Rhine, since France has allied herself with Russia.

On the negative side, I am asked everywhere: "What of the Jews?" The answer is that you simply do not see Jews in Germany! There is no doubt they have had and are still having a bad time—out of sight somewhere.

When one looks into the question one finds out that Hitler's government came into power just on the eve of a communist revolution; and in Germany large numbers of the atheist Jews were ringleaders in this communist work.

I know that right here in Canada large numbers of atheist Jews are influential in communist subversive movements; but I differentiate between the atheist communist Jew and the other Jews. The German does not. All Jews are alike to him; and personally I believe Germany is going to trip over this question sooner or later. It is not right that any people be oppressed. Even with the atheist communist, I do not believe in suppression but rather in offering something better than he has to give. But I do point out that those who preach bloodshed and

revolution must not be surprised if they feel the sword on their own bodies!

Another incident which impressed me was the confiscation one day of a whole issue of the London Daily "Times." It could not be bought that day, and afterwards I found out that an article in it was considered offensive to Germany.

The incident by itself seems small; actually, it is of the greatest significance. It means that at any time a Dictator can shut off news from the outside world. I was never so impressed with the value of freedom of speech and the press as I was over this incident. Most of what any individual says or any newspaper prints is of little value; but there is a small fraction left which constitutes liberty and true progress. If this can be stopped liberty dies. But may I emphasize the fact that freedom of speech does not mean that license may flourish as many think.

And this brings us to the question of Italy; for in that country the press has been completely controlled to exclude outside news for some time. There is no doubt that Mussolini lifted Italy out of chaos. He gave Italy back its self respect. But here we see the true path of a Dictator. He creates enthusiasm then he finds himself on a wave which he must enlarge. Step by step he inevitably finds himself at the final pinnacle—war! And a controlled press is necessary for this.

During the past few years, there has been a deliberate policy of education of the Italians on the grandeur of the ancient Roman Empire and the necessity of the return to this status. Italy has deliberately plotted warlike expansion while at the same time sitting in the League of Nations supposedly agreeing not to resort to force of arms.

There is much propaganda being spread throughout Canada from Italian sources about Ethiopia. It is a deliberate attempt to cover up an act of National deceit by pointing out the wrongs of another nation. The real issue is not what is wrong with Ethiopia, or should Italy expand; it is the question as to whether or not we are going to continue to tolerate nations saying that they will not resort to force of arms and then deliberately plot to do so.

As far as the outward problem is concerned, Ethiopia was a mere stepping stone in the original Italian plan. But they made the mistake of thinking that a kindly and generous people were a weak people. The British once aroused by injustice have never been weak in action; and after the Naval Review of July 16, 1935, the great grey ghosts of the navy went one by one silently past Mussolini's front window. It was like sending a policeman every five minutes past a house in which it was known a burglar was watching through a window! Since that time, Mussolini has realized his mistake. My own hope is that Britain may eventually show Italy how to retreat from her mistake. I always remember that Italy was our friend during the last war.

And France; what of her attitude to Italy? There is no doubt

whatever that the French were hand in glove with Mussolini up to the middle of the summer. It is a curious thing now to watch France denouncing Germany for treaty breaking when she encouraged a member of the League of Nations to do likewise! The fears of France are deep rooted in a guilty conscience.

But when one reaches Britain, it is like coming out of the atmosphere of a swamp into the clear cool of the open country. The Jubilee celebration, all will agree, was most opportune; having in mind the passing of our beloved Monarch, His Majesty King George V. It was a wonderful demonstration of affection for a man; it was also the greatest demonstration of the solidarity of that organism of free people, the British Empire.

It was my privilege to see the Naval Review as a guest of the Naval Reserve Club. We went up and down the lines of Battle Ships, Cruisers, Destroyers and Submarines; and later, as we listened to the whip and the crack and the roar of the guns as they fired the Royal salute it gave one a thrill of pride—not of possessions or national power; but that here was the front line for the final fight for the freedom of the world. For make no mistake, the present fight in the world is a battle of philosophies; and Britain stands for that freedom only to be found finally in the ideas that fundamentally actuate her people.

And one other incident which impressed me was the fact that during the King's drive through the east end of London the little youngsters jumped on and off the running board of the Royal car calling greetings to their Majesties. Such a thing could only happen in Great Britain. It was an expression of affection; but also an expression of something much better understood in Great Britain that anywhere else in the British Empire; for the British people understand what the Monarchy really means.

The King is the defender of our constitutional liberties. The King and his representatives, the Governors General and the Lieutenant Governors General watch continually to see that Parliaments at no time take away the constitutional liberties of the people.

Of course, some one immediately says; "surely Parliament never considers infringing on the constitutional liberties of the people?" The answer is to be found in how Australia a few years ago saw its Parliament dissolved by the Governor General and an election demanded over such a question. The people turned that Government out of power when they really understood what was proposed.

The reason why we have no Mussolini, Hitler or Stalin in the British Empire is because of this safeguarding of our freedom by the Monarch.

And finally may I point out and emphasize that Canada is going to be faced by many questions in the near future which will test her

ability to think clearly. We will also be subjected to much negative propaganda mainly directed toward remaining neutral.

There is an old story of the man who was set upon by robbers as he walked along the road. They robbed him and gave him a beating leaving him by the roadside. And along came two perfectly neutral men. They did not take sides either with the robbers or the beaten man. They were perfectly neutral. If we take into account the history of those times, it is safe to say that these neutral men were Pharisees. Unfortunately the term Pharisee has become a mere word of reproach; but if we examine the history of these people we find that they were the educated people of the day—and neutral.

Beware the dangers of neutrality. Stand for something; so that finally if the test comes, we may feel that at least we tried and did our best to avert catastrophe. Stand by Great Britain and the British Empire. The times may seem dark; they may even grow worse. But eventually in and through this British Empire of ours we shall see great times for all.

Job Analysis

Adapted from an Address by H. Taylor, of the Canadian National Carbon Company, to the Mechanical Club, February 26th, 1936.

The subject of "Job Analysis" is a rather broad one. Its application is such that almost every business may profitably adopt some plan. A subject with such scope may be discussed from several angles, either of which would require considerable time for proper treatment, and would require an expert to explain its many ramifications.

In presenting this subject, an attempt will be made to explain what is meant by "Job Analysis," and point out certain basic factors or fundamentals that seem to apply to all systems, in so far as they affect labor analyses.

It is not proposed to discuss the merits of any particular system, or to make comparisons. A study of existing systems will reveal that a particular phase of one system which prompts one company to adopt that system, may be the very reason why another company rejects it. It must be clear then, that whether one system is better than another depends to a great extent upon one's point of view.

History

"Job Analysis" and "Scientific Management" I believe to be synonymous. Early references of what to-day we call "Job Analysis" are referred to as "Scientific Management."

Dr. Frederick W. Taylor seems to have pioneered the field in this work. He started about the year 1885, at the Midvale Steel Company, in Philadelphia. It was some few years later when outside industries commenced to notice Dr. Taylor's work.

Dr. Taylor's researches proceeded chiefly along two lines: first, the development of tools specialized both as to design and material, and second, the development of standards of production. The results of the experiments on the cutting of tools gave to all industry the present high speed cutting tools. The result of the second series of experiments was the development of rules and principles from which were developed job standards.

In the early days several men became interested in this phase of business, and as is usually the case, their approach to the problem differed somewhat. Some of the systems developed by these men are:

The Taylor Differential System
The Gantt Task with Bonus System
The Halsey Premium System
The Rowan Premium System
The Emmerson Bonus System

There have been many other systems developed since, including that of Bedeaux.

What is Meant by Job Analysis

By "Job Analysis" is meant the breaking up of a job to see what it consists of.

The Main Uses of Job Analysis

The main uses of Job Analysis, although not necessarily in the order of their importance are:

1. To determine the relation of one job to another.
2. To develop job specifications.
3. To develop job standardization.
4. The application of incentives.

How to Analyze a Job

Before a job can be analyzed there must be some suitable means of measurement. Whatever system or basis of measurement is adopted, it should not be dependent upon a specific job, rather it should be flexible enough to analyze any physical job, regardless of its location or characteristics.

As far as is known no system has yet been devised that is not, to at least some extent, dependent upon the judgment of the analyst.

As a rule, all jobs may be divided into two main classifications, Human Factors and Mechanical Factors. The Human factors consist of those things which affect the workman, such as elements of fatigue, discomfort, and exposure to danger. The Mechanical Factors are those things which affect equipment and methods.

The Human Factors of jobs number seventeen. It is doubtful, of course, if any one job contains all seventeen factors, and even those factors that are present, will only be present in varying degrees. This condition of severity must be taken into consideration when the job is being analyzed. In mentioning the factors, some job is cited where the factor is present.

Heat—Furnace man

Eye Strain—Watchmaker

Paced Work—Take off—automatic press

Exacting—Inspection

Danger—Electrician

Fumes—Handling carbon tetrachloride

Tediousness—Handling extra small parts.

Dirt—Motor mechanic

Dust—Handling bags of flour

Contact on Body—Handling materials that will produce dermatitis.

Wet—Washing cars

Noise—Rivetting—Construction Job

On Clothes—Handling Coal

Exerted Force—Expended energy lifting or sliding—an unloader

Operating Cycle—Speed at which an operator is required to perform a job.

Working Position—Refers to whether operator is standing, sitting or working in either of several other positions.

Learning Period—Time required to learn the job.

In developing a system of measurement it is necessary to arbitrarily assign points to each Human Factor proportionate to its value in relation to the other factors. These points should represent the least favourable condition likely to be found on any job for any given factor. For example,—eye strain is presumed to exist to as great, if not greater extent, in the job of watch repairing than in any other job. The maximum points for eye strain then, represent the degree of strain present in watch repairing. Since the points assigned to the various factors are maximum values, we must, when we analyze a job, determine the extent any factor is present, so that we may allow a proportionate number of points in our analysis.

What is Meant by Base Rate

The Base Rate means the money value of a job as determined by analyzing the Human Factors, and translating this analysis into an amount of money in direct proportion as the relation of the job to the hiring rate.

The word "Base" itself is used in this work to describe other things besides rate. It is used to represent a unit of time, such as base time or standard time. It is used sometimes to represent a quantity, for example, base production or expected production. Where the base is not a money value, but rather a unit of time, an operator may earn time credits, which in some systems are paid for at the hourly rate of the workman involved.

What is Meant by Job Specifications

Any job specification should list the duties of the job. It should list all special qualifications necessary to fill the job; particularly anything unusual which will help the Employment Department in its selection.

The job specification should state whether a male or female is required, the approximate age, height, weight, strength, and educational requirements. It should show whether the job is heavy, medium, light, foot or hand operated, continuous, intermittent, monotonous, wet, dusty, standing or sitting.

Summed up, it may be said a "Job Specification" is a complete report of a job, together with a full description of the kind of workman most likely to successfully fill the job.

What is Job Standardization

Job standardization is not wage payment, but is the developing of

job standards; the finding of the one best way to perform a job at the time of the analysis.

It is the analyzing of a job from the point of view of equipment, layout, kind of materials and methods, having in mind the elimination of waste in any form. It is a study to find the best possible equipment the job and production will justify on the basis of cost and/or quality, then getting the most out of the equipment. It is a study to determine possible economies on materials, yet maintain the desired quality standards.

"Job Standardization" is sometimes called "Process Analysis." A great many illustrations could be used to demonstrate its value.

Some time ago a certain production engineer was attempting to set standards for a job of shovelling a bulk material. He conducted tests with a shovel large enough to handle 38 lbs. at one time. He changed the shovel so 34 lbs. was handled and found the workman handled more material during the day. He followed this with a shovel to handle 30 lbs., and again the quantity per day increased. He changed shovels until finally he was using a shovel handling 16 lbs. The result of these tests showed that from 38 lbs. down to 21 lbs. the production increased, reaching a maximum at 21 lbs. Below 21 lbs. the production per day decreased. It can easily be seen why the shovel capable of handling 21 lbs. was adopted as standard.

Another illustration of Job Standardization is where we have three operators, all doing the same job, and each producing the same quantity per hour. By time study or micro motion study, it may be found that the job consists of three distinct elements. It may also be found that:—

Operator A has the best method for Element 1
" B " " " " " " 2
" C " " " " " " 3

If all of the operators can be taught the best method for each of the three elements, it is reasonable to expect certain economies due to increased production.

Application of Incentive

Possibly the most important point to consider in any wage incentive plan is simplicity. Any system that is so involved and complicated that workmen cannot figure their earnings is less likely to receive the support of the workmen than is the simple system.

There is a considerable difference of opinion regarding what constitutes a fair incentive over and above normal time rates. Some think 5%, others 10%, others 15%, and some 20%. Regardless of what percentage is considered a fair incentive, it should be in addition to time rates, and not in lieu of them, otherwise the incentive is more imagined than real.

In all labor analyses it is necessary to develop standard times, or task, for normal output and desired quality, before any incentive may be applied.

Incentives may be designed for individual jobs, teams, or gangs.

The Company must decide on what its policy will be regarding payment for delays which occur through no fault of the operators. Many Companies pay time rate for such delays.

There is another important factor in the application of incentives, and that is the allowance for fatigue and personal comforts. This varies with different systems, and even on different jobs, when the same system is used.

Cost Accounting

Job Analysis may not be a function of the Cost Dept., yet anyone engaged in cost accounting will readily recognize the necessity for close co-operation between the accounting division and that of production engineering.

Labor cost variations, as noted by the Cost Dept., are frequently tell-tales of inefficiencies which require some study by the Production Engineering Dept. in order to reduce or possibly eliminate them.

The Cost Dept., of which the payroll division is usually a part, is generally responsible for preparing a report of earnings on the various rates in effect, so that unusually low or high earnings may be checked for change in method.

In those Companies where standard costs are used, it is desirable to check the Production Engineering Dept. for contemplated changes in rates, or the establishing of new rates before setting standards.

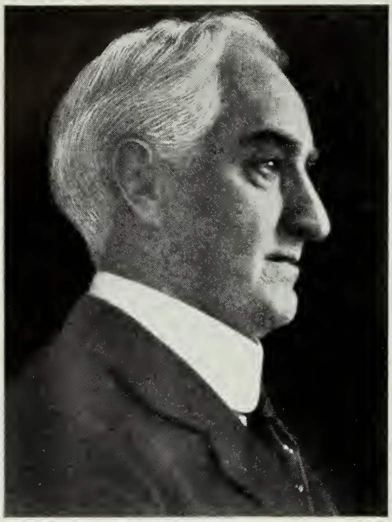
Conclusion

With some plan of Job Analysis, the chance of establishing wage differences for like jobs is lessened. Job Analysis should seldom, if ever, be adopted as a separate function in any Company. It should be a part of a well balanced development which is carried throughout the entire organization.

When Job Analysis is tied in with planning and control, it is possible to effect economies not otherwise obtainable, and any company that has not adopted some system of Job Analysis might do well to investigate its possibilities.

Dr. T. Kennard Thomson at the Semi-Centennial Convention

Extracts from the address to the General Meeting, by the founder of our Society and Guest of Honour at the Semi-Centennial Convention, Royal York Hotel, February 21st, 1936.



All that we, of 1885 and 1886 did, was to hitch the horse to the buggy under the direction of Professor Galbraith, and hand him the reins.

After four terms Prof. Galbraith insisted on handing the reins over to H. E. T. Haultain, '89.

It has been a great gratification to us, to sit on the side lines and watch The University of Toronto Engineering Society keep pace with the railroads, automobiles, airplanes and radios.

I started school at the age of 13 at Upper Canada College, which then occupied the block between King, Simcoe, Adelaide and John Streets.

G. R. R. Cockburn was Principal of Upper Canada College from 1861 to 1881; and that finest type of an English gentleman, John Martland (dear old "Gentle") was head of the Boarding House.

He maintained perfect discipline, but never tried to "catch us."

Whenever he returned to the building, he would let out a roar, as soon as he entered the front door, so that we would all know that he was in, and we all quieted down at once.

Once in a while, a rubber soled sneak would get a job as Teacher, but he never lasted long under Martland.

While at U.C.C. I was prepared for Confirmation at St. James Cathedral by an exceptionally great man — the late Rev. Wm. S. Rainsford, then a young man just out from England, whose talents were so great that the first J. P. Morgan took him away from Toronto and gave him a much wider field in St. George's Church, New York, and saw that he had plenty of funds for charitable purposes.

No Minister was ever more favorably known in New York, where he continued his good work for many years.

I well remember that Mr. Rainsford always wound up his lesson, with a story to illustrate his point — and one Sunday I think he made the point to fit the story, which was:—"If one can not do a thing the right way it is much better not to do anything, for instance:—the preceding day (and this actually happened) a man fell off the Yonge Street wharf. A bystander rushed around yelling 'save him, save him,' but as no one seemed to be doing anything he thought that he would have to do something himself.

So — he grabbed a log of wood, threw it to the man in the water, hit him square on the head, and knocked his brains out. The Rev. gentleman remarked that while the man had the very best intentions in the world, it would have been better if he had not done anything."

School of Practical Science

Over 85 per cent. of the entrants of the first year, 1878, of the S.P.S., did not graduate, for one reason or another. It was 80 per cent. in my year, and I believe it is 30 or 40 per cent. now. But make no mistake, the non-graduates include many very able men.

Professor Galbraith founded the School of Practical Science in 1878, and for years was modestly satisfied with the title of Professor, although he was The Head of the School.

Galbraith was President for the first four terms of our University of Toronto Engineering Society, and but for him I am sure that I could not have graduated from Toronto nor any other University.

For, with only five years schooling before entering the S.P.S. I was very inadequately prepared — and deaf.

I was even sick in bed shortly before my first year's Exams, well knowing that I was not well qualified, duly and truly prepared. Naturally I was plucked in the Spring of '83.

I was fortunate in securing work on the Canadian Pacific Railway in The Rockies, for the summers of 1883-4-5, and before starting out I called on Professor Galbraith, explained the situation and asked his advice as to whether I should stay out on the railroad or come back and take the year over again.

Professor Galbraith evidently sized me up as having plenty of self esteem, for he said what he in after years told me he would be afraid to say to many for fear of discouraging them, "*If you think that you can pass the Exams next year, by all means come back,—if you don't think so—better not.*" That hit my conceit so I at once said I would come back.

Professor Galbraith's favorite vacation, before he married, was to take a canoe trip, either by himself or with an Indian guide. In 1885 he went to Winnipeg and travelled east keeping accurate notes —which he allowed me to plot, during the following winter. I copied from his notes:—"*This point is undoubtedly very rich in minerals.*"

Some 18 years later — that point was found to be the center of the *COBALT DISTRICT*.

If Galbraith had wanted to make millions, which he did not — he had his chance then and there.

He was never adequately paid, financially, for his work in founding and building up the School of Practical Science.

He well knew that he could have received much higher salaries (ten times as high) in the States, but his heart was in his work here and here he stayed, although we had the pleasure of seeing and hearing him many times in New York.

It is hard to stop talking about our First Dean — so I will simply say that recently I have heard up to date Presidents of great Universities announce radical innovations in professional education — mentioning the same innovations that John Galbraith adopted 58 years ago.

He repeatedly told us that he was not trying to turn out full fledged Engineers — which would be impossible, that all he was trying to do was to teach us how to study so that whenever we had a new job we would know how to tackle it.

He arranged the long summer vacations to enable the students to get work during the summer, as most survey parties started out early in the spring. He knew that the practical work in the summers, would enable us to derive much greater benefit from the lectures in the winter. He advised us not to try to get a permanent job on graduation, but to move around for some years or until we found out what we were really best fitted for.

Another good piece of advice was:—"Never be afraid of losing a job, but always do the work so that your employer would be afraid that you might leave him."

Allow me to repeat the advice I have given S.P.S. boys before:—

Get married young — to a Toronto girl.

When looking for a job in U.S.A. always start by saying: "*I am a Canadian.*"

Nearly forty years ago my good friend Alison called at half a dozen New York architects' offices, looking for a job. He came to the conclusion that the architects never even saw his card nor heard of it.

Then he thought it a good time to visit his parents in Toronto and while there sat down and wrote to the same half dozen firms. They all offered him a job and he selected the one he liked best.

Unfortunately, in recent years the Immigration Laws prevent such opportunities—

But, as I said before, if you are *in* the United States looking for work, start by saying

"*I am a Canadian.*"

Fig. 1—Tied Arch Bridge, Ormstown, Quebec.

Recent Developments in Structures

Condensed from an address to the Civil Club at the Fiftieth Anniversary Convention, February 21st, 1936, by C. R. Young, Professor of Civil Engineering, University of Toronto.

Despite the financial handicap that has existed during the past few years remarkable developments in the design and building of structures of many classes have taken place. While in most instances the larger enterprises have been publicly financed, there have been important innovations introduced by private organizations interested in the commercial development of materials or systems of construction.

Steel Structures. In Europe a strong trend towards the use of long span plate girders continuous over several piers has been manifested. For example, the Dreirosen bridge at Basel, Switzerland, contains a main span of 344 ft. composed of plate girders 14.1 ft. deep with horizontal web splices along the neutral axis.

Much use has been made, in Belgium and Holland particularly of the Vierendeel truss, which is a truss without diagonals, and in which the truss members are subjected to large bending moments at the joints. The rapid development of structural welding has facilitated the use of

this type of truss, and the longest truss span completely welded is the Herenthals bridge in Belgium, with a span of 175 ft.

Much promise for the life extension of old steel bridges is afforded in the successful reconstruction of the floor of the Smithfield Street bridge, Pittsburg, with an aluminum alloy having a yield point of at least 50,000 lb. per sq. in. and an ultimate strength of 60,000 lb. per sq. in. As a result of replacing the old steel and wooden floor by one composed of beams of the alloy carrying battledeck plate flooring, the annual savings in 25 years will amount to the cost of a new bridge.

Extension of the use of continuous types of bridges has gone on apace. An important example in Canada is the recently completed Honoré Mercier bridge over the St. Lawrence, at Lachine, in which the main arch and the two side spans are continuous over four piers.

While the record for long span steel arch construction still rests with the Bayonne bridge at New York, with its span of 1675 ft. between bearings, the recently completed 1080-ft. highway arch span over the Sabi River in Southern Rhodesia adds an important chapter to bridge history through the use of a high strength chrome-manganese-copper steel. This material, known to the trade as Chromador, carries about 1 per cent. of chromium, 1 per cent. of manganese, and 0.5 per cent. of copper. As a result it is particularly resistant to corrosion.

The use of rigid frame structures in steel continues, the record of span now resting with the 227-ft. Wilhelmsbruecke at Stuttgart. A growing use of arches with very slender ribs and with a deep and rigid stiffening girder at the floor level is to be observed. A recent important example of this is the 262-ft. span at Hutbergen in Germany. An interesting application of the tied arch to highway uses in Canada is the 140-ft. span built recently at Ormstown, Quebec, by the Dominion Bridge Company, Limited, and illustrated in Fig. 1. The distortion under unsymmetrical load is, in this instance, looked after by the bending strength of the arch rib. The advantage of clearness of vision for the users of the bridge is apparent from the illustration.

Suspension bridge construction has been particularly active in the past few years. An important example in Canada is the recently completed 1059-ft. main suspension span of the bridge over the St. Lawrence River between the North Shore and the Island of Orleans. The two 2,310-ft. spans of the San Francisco-Oakland bridge are well under way, as is the record-breaking 4,200-ft. span of the Golden Gate bridge. In the latter the two 36½-in. diameter cables hold the record for size, although the total carrying capacity of the bridge is less than that of the 3500-ft. George Washington span at New York.

A remarkable innovation was introduced in the 544-ft. vertical lift span over the Cape Cod canal at Buzzard's Bay. The four 15-ft. diameter sheaves, each carrying a load of 1,000,000 lb. rest on roller bearings, the requisite operating power being cut thereby from 600 h.p. to 300 h.p.

Reinforced Concrete Bridges. Observing the value of flat slab construction in building work, bridge engineers have now applied the system to concrete viaducts, as in the West Garfield Street bridge at Seattle. A girder span of 224 ft. has actually been constructed by the cantilever process at Herval in Brazil, and many cantilevers with the conventional suspended spans have been built in Europe. A recent example in Canada is the Cockshutt bridge, near Brantford.

One of the cleverest developments in recent years has been the reinforced concrete tied arch with inclined hangers, invented by Dr. O. F. Nielsen. The simple device of inclining the hangers has made it possible to reduce the bending moment in the arch rib to 10 per cent. of what it would otherwise have been. A span of 470 ft. has been built at Castelmoron in France.

While at present the record of span for concrete arches is the 585-ft. clear span of the Tranebergssund bridge at Stockholm, a span of 627 ft. is, however, under construction over the Esla River in Spain.

Buildings and Tanks. Little tall building work has occurred during the last few years and the record of height, although not the record for volume, rests with the 1250-ft. tower of the Empire State building, at New York. A relatively bolder type of construction is found in the extremely thin shell roofs now being built in Europe. One of these, the Market Hall at Leipzig, a dome-like structure, has a span of 250 ft. with a shell thickness of 3 9/16 in. Designs have been prepared for spans as great as 500 ft., using the same system.

In the effort to increase the capacity of tanks while still keeping the bottoms relatively flat the new radial cone type of steel tank has been developed. This makes possible the handling of a large volume of water with small variation in head, while still using the suspension principle in the floor.

An interesting use of the reinforced concrete tank is found in the Washburn Park standpipe at Minneapolis, constructed according to the Hewett system. In this the tank shell was constructed of plain concrete and allowed to take on some of its shrinkage, after which steel hoops were placed around it and tightened up, producing a high initial compression in the shell. Similarly, vertical rods were made to produce a vertical compression in the concrete. The prestressing was so fixed that under the water load there would be zero tension in the concrete.

Foundations. Extraordinary difficulties in constructing the south main pier of the Golden Gate bridge were overcome by placing the pier inside a concrete fender ring. The original intention of sinking a large caisson inside this ring had to be abandoned because of the violence of the wave action and the pier was founded on a large mass of tremie concrete.

Further extension of the sand island method of placing piers in deep water has been carried on, as in the piers of the New Orleans bridge which were carried to a depth of 170 ft. below water.

The domed caisson, by which sinking was controlled through the use of compressed air within the dome-covered cylinders of the caisson, was employed with remarkable success in building the piers of the west channel of the San Francisco-Oakland bridge, which were carried to a maximum depth of 240.7 ft. below mean tide.

An outstanding example of ingenuity in foundation work was the launching and reversing of the caissons of the Little Belt bridge, in Denmark, which were built on the ways upside down.

Dams. Much important work in the construction of dams has been carried out, particularly in the United States. The outstanding example, of course, is the Boulder Dam which has now been completed with conspicuous success. The chief novelty has been the cooling of the enormous mass of concrete, amounting to three and one-quarter million cubic yards, by the passing of refrigerated water through a maze of pipes embedded in the concrete. By this means an interior temperature as high as 130° F. was lowered to 40° on the upstream face and 70° on the downstream face.

Speech and Music and Their Relation to Transmission Problems

Condensed from an address by D. G. Geiger, of the Bell Telephone Company of Canada, Toronto, to the Electrical Club at the Fiftieth Anniversary Convention, February 21st, 1936.

Since the advent of radio broadcasting a widespread interest has been aroused in the transmission of speech and music. Although before this time nearly everyone was familiar with the telephone and its transmission of speech, and in some cases music, it was considered merely as a part of their daily life and no astonishment was expressed at its performance. In the case of radio, however, the quality and volume of the received speech and music vary through wide ranges and are somewhat at the contol of the man at the receiving end.

In the telephone business we are primarily concerned with the transmission of speech. The subscriber wishes to communicate with others easily and understandibly. For this use, the main requirement is intelligibility, although in recent years improvements in the art have gone beyond just the provision of intelligibility. However, in the transmission of music or in broadcasting speeches the entertainment function makes it important that the naturalness of the speech and music be preserved.

In order to properly give this service, the telephone engineer has had to solve the transmission problem somewhat as follows:

(1) The determination of the physical nature of the sounds to be transmitted from one place to another;

(2) The knowing what reactions the transmission system has upon these sounds.

From these two, one is enabled to predict the characteristics of the thing which is delivered to the receiver, be it a telephone set or a radio receiver. To this information, however, must be added a knowledge of the effects of any such distortions as may occur upon the interpretation given by the ear.

It is my purpose in this paper to discuss the two problems outlined above.

Let us consider for a moment the mechanism of speaking. The organs of speech are the lungs which, by their bellows-like action, supply the streams of air which pass in and out through the vocal passages, the vocal cords, the tongue, the lips and the cavities of the nose and throat. These impress on the air streams variations which are heard as speech sounds. The vibration of the vocal cords, which are a pair of muscular ledges on both sides of the larynx forming a straight slit through which the breath passes, starts a train of sound waves which are conducted through the vocal passages. These passages

impress upon it certain resonant characteristics, the vibrations finally emerging from the mouth as speech sounds. The so-called voiced sounds are produced in this manner. These include all the vowel and consonant sounds except p, t, ch, k, f, s, th (thin), sh. The vocal cords do not enter into the production of the last-mentioned speech sounds but they are produced by certain vibrations set up in the mouth itself.

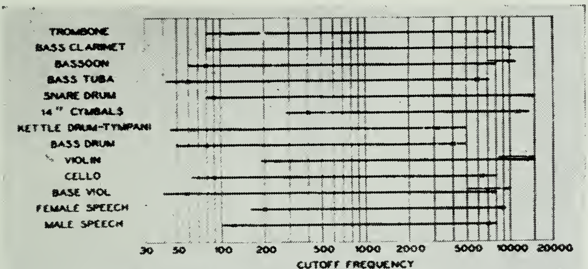
The voiced sounds may be divided into two classes: those produced by a continuous flow of air, which may be called the continuants; and those produced by a sudden stoppage in the air passages, which may be called stops. There are two variable resounding cavities through which sounds from the vocal cords pass, namely, the throat and the mouth cavity. For this reason the speech sounds called the continuants are characterized by having their frequencies in two principal regions very much magnified. For example, if we speak the sound *a* at various pitches the fundamental frequency of this speech sound will vary; but it will be found that those harmonics near 560 and 2000 cycles will always be greatly magnified regardless of the pitch. It is largely these particular regions of resonance that distinguish it from other sounds. Similarly, the vowel *u* is characterized by the resonant regions 475 and 4000 cycles, and the vowel *o* by the resonant regions 600 and 3500.

Use of this knowledge has been made in aiding those unfortunates who have had to undergo the surgical operation known at Tracheotomy, which operation leaves no connection between the lungs and the mouth. When a patient recovers from such an operation, the process of breathing is carried on by drawing the air in and out through a small opening in the neck. Consequently, the patient can make no vocal sounds. If an attachment is made to the opening of the windpipe so that the patient can blow a whistle such as is used in toy balloons and the sound is directed into the corner of the mouth, the patient can learn to talk again.

Let us now consider the physical nature of musical sounds. They are characterized by being sustained at definite pitches for a comparatively long time and by having the changes in pitch take place in definite steps called a musical interval;—thirds, fifths, octaves, etc. There are two outstanding physical mechanisms besides the voice for producing musical tones; namely, vibrating strings such as the piano, violin, etc., and vibrating air columns, such as the pipe organ, flute, horns, etc.

A single note sounded by one of these musical instruments contains more than one frequency and is in fact a complex tone. The pitch of the tone is that subjective characteristic which enables the listener to locate the position of the tone on a musical scale. For most musical tones the component frequencies are multiples of a fundamental which is the lowest frequency present, and for the case of such tones this fundamental frequency may be considered as the frequency corresponding to the pitch of the tone. It is the abundance and relative arrangement of the harmonic components which produce the richness and

quality of musical tones, and speaking generally it is the relative magnitudes of these components which enable the listener to recognize the kind of musical instrument producing the tone, that is, whether it is a cornet, a flute or a violin. This latter characteristic is generally referred to as the timbre of the sensation produced.



Summary of important ranges required for different instruments.

Fig. 1

It is interesting to note that the voice and piano have large numbers of relatively intense harmonics while the violin is more nearly a pure tone. In the case of the cello organ pipe, the second, third and fourth harmonics are all larger than the fundamental. It is this richness in harmonics that gives it the cello character.

In the case of pipe organ music, the principal charm is contained in the strong bass notes whose fundamentals correspond to the range below 100 cycles. Although the older types of electrical circuits used in broadcast transmission were somewhat inefficient at these low frequencies, the principal offender is usually the loud speaking receiver in the radio set. Laterally the transmission systems have been improved to better the transmission within this range and also broadcast receivers have been improved in this range.

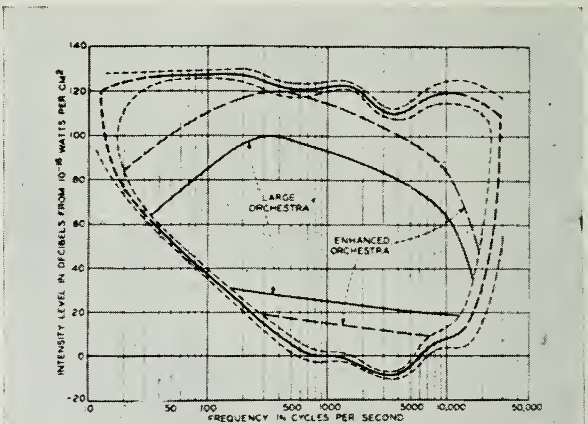
From what has been said it will be seen that much is required of the transmitting medium between the concert hall or studio and the receiver to ensure the successful reproduction at the receiver of the required sounds.

What then is required of the transmission facilities to assure delivery to the receiver of waves of good quality?

For one thing the system must be capable of transmitting a wide band of frequencies without changing their relative intensities. Figure 1 gives some data in regard to the frequency range required for different musical instruments as well as speech. It will be noticed that at the lower frequencies little appears to be lost by cutting off frequencies below about 50 cycles, although the pipe organ (not shown) probably would require the transmission of frequencies somewhat below 50 cycles.

At the upper frequencies something is lost, with certain of the instruments, by cutting off frequencies above 8000 cycles. Tests have shown, however, that when the frequency range 35 to 8000 cycles is transmitted with little distortion the results obtained are very pleasing.

The relative transmission delays suffered by the different portions of the frequency band must also be considered. Over wire lines and through amplifying equipment, the time of transmission tends to differ for the various frequencies transmitted. Tests have indicated that there are certain maximum delays which impose stringent requirements on the transmission system.



Limits of audible sound as determined by recent tests.

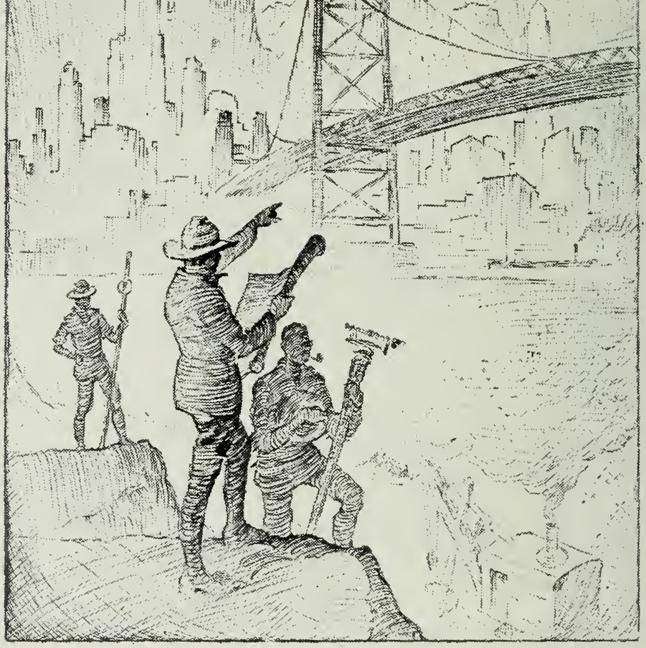
Fig. 2

Nothing in the transmission system must produce spurious frequencies except in minute quantities. For this reason, amplifiers must have extremely small overload or modulation effects and any magnetic circuits must be operated over a range in which the ratio of flux density to ampere turns is substantially constant.

A favourably-seated listener to a high-grade symphonic orchestra is treated to a wide range of volumes of about ten million to one or 70 db. The human ear can hear volume ranges as shown in Figure 2, in which the ordinates indicate decibels relative to a reference intensity of 10-16 watts per square centimeter. Allowing 10 db at the lower intensities for the masking of sound in a concert hall due to audience

noise, there is approximately a 100 db range in intensity that an audience could appreciate. This is about 30 db greater range than that available from a large symphony orchestra. For rooms in residences, a range of about 40 db has been found most satisfactory. Any greater range results in either room noise masking of the quieter passages or undesirably large volume during the loud passages, or both. In the case of radio reception the level of static noise is also a factor determining the lower level of the range.

From the standpoint of the transmission system, the maximum volume of a wire program transmission system is limited by the requirement that the program material must not cross-talk unduly into neighbouring circuits and the minimum volume is limited by the tendency of the noise present on the circuit to annoy the listener during quiet passages and by the possibility of cross-talk from adjacent circuits. A recently developed transmission system for cables has been designed to handle a 40 db volume range.



C. S. Grassick

YEAR BOOK


R.A. Boyle
President Athletic Association
G.F. Beard
Secretary
A.R. Stewart
Treasurer
C.E. Burnett
1st Vice President
W.M. Lawrason
President
H.N. Potter
2nd Vice President
M.P. Johnson
Director of Publications and Publicity
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Boating Club Chairman
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W. T. Turrall
Mining and Metallurgical Club Chairman
J.G. Welsh
Civil Club Chairman
R.J.K. Barker
Architectural Club Chairman
F.M. O'Flynn
Chemical Club Chairman
F.A. Fleming
Electrical Club Chairman
W.F. Taylor
Mechanical Club Chairman
G.E. Smith
President 4th Year
J.V. Leworthy
President 3rd Year
J.R. Millar
President 2nd Year
L.T. Redman
President 1st Year

Asleep in the Deep

ONCE again at the point of a gun, we have persuaded that mighty mystic, Uncle Gustav, to brush the foam from his beard long enough to tell us about his hair-raising experiences at S.P.S.

"There is no doubt," said Uncle Gus, flipping off a top and groping for a mug, "that four hectic years at School will increase anyone's entropy in spite of all efforts to the contrary." Sensing Uncle's tendency to be tiringly technical, we snatched the coloured pencils from his pocket to prevent him drawing a vector diagram.

"Well then," he said breaking into native Gaelic, "I shall tell you about some of the good stout fellows I used to get under the table with."

"Foremost in my Dream Book is Willie Lawrason, who was always known as the president behind the pipe. The pipe alone made his presence appreciated, for he had a habit of burning a mixture of orange peel, oakum, and old shoe tongues to give a smoke screen effect. Then there was that prominent young man named Annis. His was a devilish genius, borrowed from the notorious inquisitors of Spain. The cruelty of his brain was well shown when he evolved the flitchgobber—a device for producing the sound of horses tramping on steel, followed by a fanfare of trumpets. His reputation for humour of a better kind led to his present position as Secretary to the National Council of Clergymen. Oh well.

"A well-built young lad by the name of Bruce used to cause much worry and concern. Doug always wore a working shirt—that is, it kept working up out of his pants. I just heard the other day that Doug is starting on his second million.

"And how well do I remember old Whistlebritches Moth Eaton. My gawd, how that man could whistle—and sing—and whistle. He was a nice fellow though, in spite of it. And what fine physical form —a chest like a monk's wine cask. They say he now models for a firm that specializes in door knockers.

"Then there was a certain young Electrical named Peter, the Johnson. He was a man of no mean literary and journalistic accomplishments. Just give him a typewriter and some paper, and ten editors and two dozen reporters and a stenographer, and about one hundred dollars and he could put out an issue of Toike Oike within a month. Real efficiency —plus!

"Then there was our deep philosopher Welsh, a civil by trade but a Schoolman just the same. I think we are indebted to him for that great

contribution to our contemporary thought, "why use two when one will do?"

"There was good old Terrible Turrall, the Turk, a great man and a miner (both at once). I thought I saw Bill sober the other day, but it turned out to be somebody else. What a relief!

"The Chemicals were a great bunch. From their lists came those two great names O'Flynn and Press—scientists of a high grade. While just a mere youth at School, Tom invented a machine for keeping one's nose to the grindstone during exams. He tried it out on Paddy, and it distorted his defactory sense to such an extent that, even to-day, an old corncob pipe smells like a dozen moth balls to him. S' help me!

"Do you remember old Lead-pipe Millson, the great fighter? I think they gave him a Bronze S. Well sir, a funny thing happened to John a little while ago. He was running a tunnel through a big hill, and in the heat of battle, he got his steam tables mixed with his log tables and instead of a tunnel, he finished up with a scenic railway and a swell set of dishes.

"And now," said Uncle Gus swinging himself deftly into the chandelier, "I think it's about time that I got back to work."

"And what do you do now?", we asked breathlessly.

"There's no doubt about it," he said, "but always remember never to cross your skiis, except over the fireplace."

Election Results

FRIDAY, FEBRUARY 28, 1936

Engineering Society Executive

President, H. N. Potter (acclamation)
First Vice-President, J. V. Leworthy.
Second Vice-President, G. F. Beard.
Treasurer—A. H. Kingsmill.
Secretary—G. B. Dewart.

Athletic Association Executive

President—R. L. Clark.
Vice-President—L. Chambers.
Secretary-Treasurer—J. D. Fox.

Club Chairmen

Architectural Club—F. N. Smith.
Civil Club—W. H. Lowe.
Chemical Club—K. O. T. Beardmore.
Debating Club—A. E. Johnstone.
Electrical Club—H. L. Tipple.
Mechanical Club—W. R. Trusler.
Mining & Metallurgical Club—D. E. G. Schmitt.

3*T*6 *Permanent Executive*

President—R. B. McIntyre.
Vice-Presidents—W. M. Lawrason, C. C. Hoag.
Secretary-Treasurer—C. L. Annis.

Councillors—R. A. Boyle
E. R. Eaton F. M. O'Flynn
A. W. Jacob W. F. Taylor.

Bronze "S" .... J. C. Millson

3*T*7 *Executive*

President—F. C. B. Hall.
Vice-President—W. H. Arison.
Secretary-Treasurer—C. G. Lumbers.
Athletic Representative—D. G. Willmot.

3*T*8 *Executive*

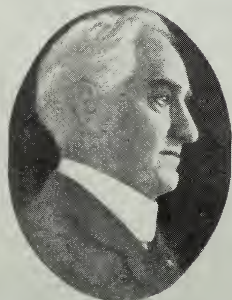
President—D. B. Ross.
Vice-President—F. Wooldridge.
Secretary-Treasurer—G. W. Ridpath.
Athletic Representative—N. Hogg.

3*T*9 *Executive*

President—P. C. Anderson.
Vice-President—J. H. Gordon.
Secretary-Treasurer—G. Ragan.
Athletic Representative—J. M. MacLeod.

~ UNIVERSITY of TORONTO ~ ENGINEERING ~ SOCIETY ~

SEMI - CENTENNIAL


Dr. T. K. Thomson


Dr. J. Galbraith


Prof. H. E. T. Haultain

The University of Toronto Engineering Society Semi-Centennial

The University of Toronto Engineering Society history and traditions are things towards which every "Schoolman" points with justifiable pride.

To every member of the Society the name of Dr. J. Galbraith is known and revered. He was the founder of "School" and his personality, breadth of vision, sympathetic understanding of human nature, and strength of character formed the foundations from which School traditions grew. Under the genius of his guiding hand was shaped the early history of the School of Practical Science. Dr. Galbraith was president of the University of Toronto Engineering Society from its conception in 1885-86 until 1887-88. The sincerity with which the younger members of the Society honour the name of Dr. John Galbraith and the reverence with which the older members recall memories of him was magnificently demonstrated by the tribute paid him at the Semi-Centennial dinner when a "Galbraith Society" was formed. The object of this Society is to prepare and properly record the history of the Engineering Society, from the days when it was first conceived by its founder, Dr. T. Kennard Thomson.

Dr. T. K. Thomson, the Engineering Society's guest of honour at their Semi-Centennial Convention, may truthfully be referred to as the "founder" of the Society. It was at a small dinner given by Dr. Thomson, then an undergradute, that the idea of a University of Toronto Engineering Society was proposed by him. Although afflicted during his entire life by deafness, the handicap has not prevented Dr. Thomson from becoming one of the most eminent engineers on the continent. He is still one of the most active members of the Society which he founded, and the honour bestowed upon him in unanimously electing him to the honourary chairmanship of the "Galbraith Society" is a commendable tribute to one of the Society's greatest men.

Professor H. E. T. Haultain became the University of Toronto Engineering Society's first student president in 1888-89. Then an undergraduate, H. E. T. Haultain delivered an inaugural address which is now one of the Society's most valued documents. Now head of the Mining Department in the Faculty of Applied Science and Engineering, Professor Haultain is still one of the Society's most outstanding members and his sincere interest and invaluable help in connection with the Semi-Centennial Celebrations marked another milestone in the history of the Society into which the name of Professor H. E. T. Haultain is so closely woven.

History of the Engineering Society

The year 1885 may be marked without fear of contradiction as being a red letter year in the history of undergraduate life in School, for it was then that the Engineering Society came into being.

In 1885, Herbert J. Bowman suggested that S.P.S. should put on an exhibition at the University Conversazione. A camp was made with levels, transits, etc. Here T. Kennard Thomson first suggested an Engineering Society, but he was told by all that the School was too young. Thomson, however, invited Principal John Galbraith and Dr. Ellis and the entire class of '85-'86 to his place for dinner, and there made his suggestion of an Engineering Society. Principal Galbraith endorsed it, and a committee was formed on the spot to draw up a Constitution. They felt that Principal Galbraith was the only man for president, and he accepted only on condition that he retire when a suitable undergraduate appeared.

The organization committee consisted of Professor J. Galbraith, president; T. K. Thomson, secretary; B. A. Ludgate as third year representative; J. R. Gordon and J. C. Burns as second and first year representatives, respectively.

The first publication of the Engineering Society appeared in 1887. It consisted of a forty-three page booklet containing seven pages which had been read before the Society, mostly by undergraduates, during 1885-86. Publication continued annually until 1908, when "Applied Science," a monthly periodical, put in its first appearance.

During 1887-88, the general committee of the Society was: President, Professor Galbraith; vice-president, C. H. C. Wright; secretary-treasurer, H. E. T. Haultain; corresponding secretary, G. H. Richardson.

In 1888 a radical departure was made, in that the Engineering Society had a student president for the first time. The general committee consisted of: President, H. E. T. Haultain; vice-president, T. R. Rosebrugh; secretary-treasurer, J. Samon; and corresponding-secretary, F. X. Miel. All of these men were undergraduates at the time.

Professor Haultain says that "Johnnie" (Professor Galbraith) always insisted that the Society should be run entirely by students. Professor Haultain, as first president, started a library for the Engineering Society, many volumes being contributed by Colonel Gzowski. The first volume bought by the Society was Rankin's "Civil Engineering."

The first Society dinner was held at the Hub, January 31st, 1890. Fifty-four were present, among them, C. H. Mitchell, the present Dean, who was then freshman representative on the executive.

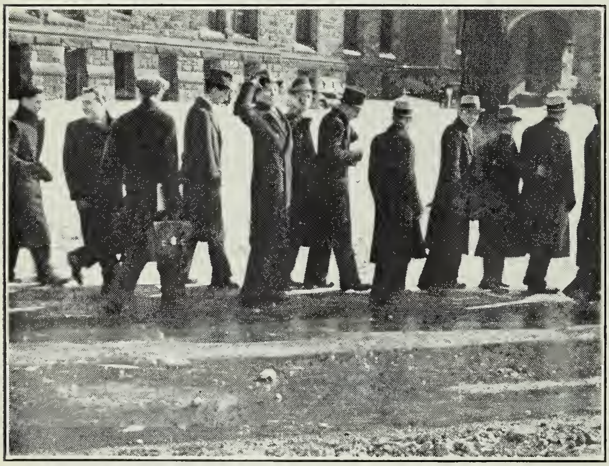
In 1907, "Applied Science" was initiated under the managership of K. A. McKenzie, president of the Society in 1906. This was really "Transactions" in monthly form, and while very successful in its early years, it was found impossible to carry on the work of turning it out.

It was this same year that saw one of the most critical times in the history of the Society. The supply department, inaugurated a few years previous to this time, had developed enormously, but was still being handled by a student secretary. The meetings were large and unwieldly, the graduates were rapidly increasing in number, and no attempt was being made to keep alive their interest in the faculty. In fact, unless radical changes were to be made in the constitution, the society was in for trouble.

It was on the initiative of Mr. McKenzie that a new constitution was drafted. Provision was made for sectional meetings, and the appointment of a permanent secretary for the society. This move had a far-reaching effect outside the undergraduate body. One of its outstanding effects was the formation of the Engineering Alumni Association. Up to that time no such organization had existed. Hence, it was a direct result of the Engineering Society that this body was founded.

J. W. S. VILA.

"An engineer is, by Nature, a Scotchman", says Dean Wintchell, and whether it's to pipe in the turkey at a School Dinner or to pipe the Schoolmen off to their 50th Anniversary Convention, there'll be the rolling of a drum and the skirl of Scottish pipes, Egad.



There's old Jim right in the thick of the parade. As they are seen here, the boys are scarcely under way on their march to the Hotel. Yet "Dick" Noyes, there in the centre, has a crimp in his back already, and J.H. Govan thinks that that old stogie is going to give him a "lift". As we recall, John was carried the last four blocks, poor chappie.

"Off in a cloud of dust" Only there was no dust, and the walking was too slippery to get away in any grand burst of speed. The Royal York Hotel, scene of the Big Reunion and Convention, is just another mile or so away.

Civil Club

The Civil Club of the Faculty of Applied Science and Engineering, composed as it is of all students taking the Civil Engineering Course, endeavours to fulfil a two fold purpose. It has aimed to develop a close and lasting fellowship among its members, and to bring to them men who are outstanding in the field of Civil Engineering to discuss the most recent developments. To this end a number of activities have been promoted.

On October 18, the second, third, and fourth year Civils journeyed to Niagara Falls and Buffalo to visit the Carborundum plant and the Grand Island Bridges.

The Club's first meeting took the form of a dinner at which an excellent description of Toronto's proposed tunnel to the Island was given by its designer, Mr. Alport.

The Club Dance, held in the Oriental Room, Diana Sweets, on January 15, lived up to the high standards of Civil Club entertainment.

Three exceedingly interesting smokers were held in Hart House, at the first of which Professor T. R. Loudon spoke on "The European Situation." Early in February three of the fourth year civils, Messrs. Gooch, Self, and Taylor gave talks on their theses; while on February 17, Mr. G. A. McCubbin spoke to the club on some drainage problems.

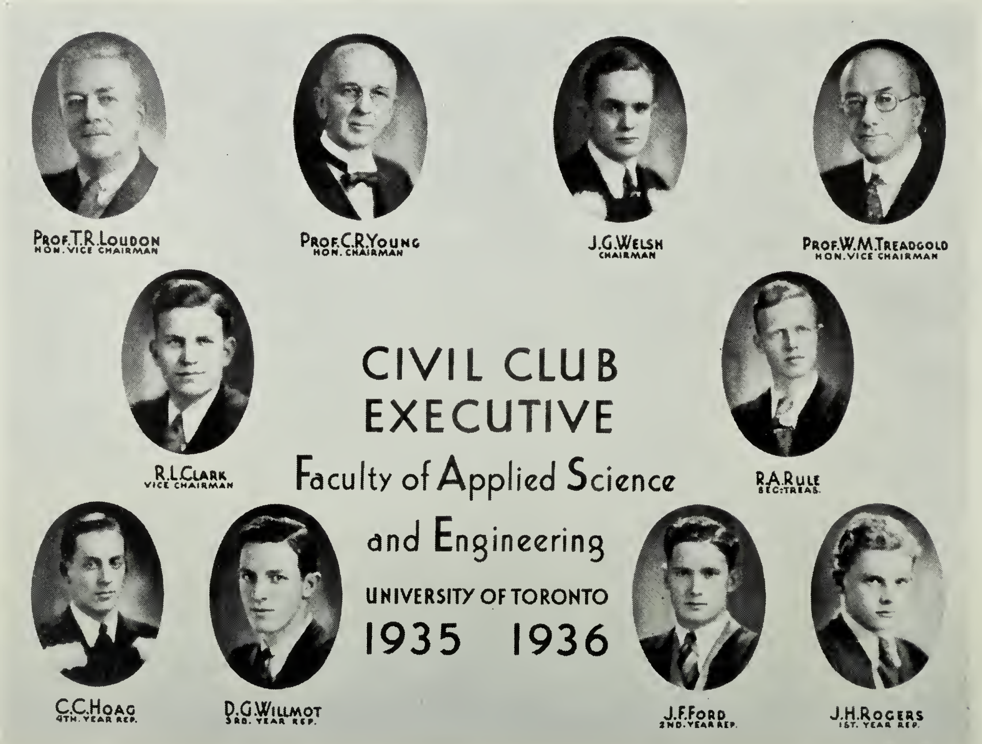
Towards the middle of March the Club activities were brought to a conclusion with a luncheon meeting at which Mr. E. G. Hewson of the C.N.R. was the speaker.

As a further stimulus to greater fellowship a bowling tournament was conducted throughout the year and at the time that this write-up was submitted, the rivalry was still very keen.

It is with sincere appreciation that the executive extend a vote of thanks to the members of the Staff and to all the undergraduates who in any way contributed to the success of the Club functions.

J. G. WELSH,

Chairman.


PROF. T.R. LOUDON
HON. VICE CHAIRMAN
PROF. C.R. YOUNG
HON. CHAIRMAN
J.G. WELSH
CHAIRMAN
PROF. W.M. TREADGOLD
HON. VICE CHAIRMAN
R.L. CLARK
VICE CHAIRMAN
CIVIL CLUB
EXECUTIVE
Faculty of Applied Science
and Engineering
UNIVERSITY OF TORONTO
1935 1936
R.A. RULE
SEC.-TREAS.
C.C. HOAG
4TH. YEAR REP.
D.G. WILLMOT
3RD. YEAR REP.
J.F. FORD
2ND. YEAR REP.
J.H. ROGERS
1ST. YEAR REP.

FOURTH YEAR CIVILS

BACK ROW: F. S. Hutton; H. W. Royl; P. W. Gooch; F. A. Sweet.

SECOND ROW: S. M. Kennedy; N. M. Kelly; R. H. Miller; T. M. Dembitzky; J. S. Elliott; W. E. Ewens; J. T. MacDonald; R. G. Wykes.

FRONT ROW: D. E. Raymer; R. H. Self; Prof. W. J. Smither; Prof. C. R. Young; J. G. Welsh; C. C. Hoag; Prof. W. M. Treadgold; Prof. T. R. Loudon; F. W. Taylor.

ABSENT; R. M. Chute.

FOURTH YEAR MINERS AND METALLURGISTS

FRONT ROW: Prof. J. A. Newcombe; Prof. J. E. Toomer; Prof. G. A. Guess; Miss V. A. Jordan, (Sec.); Prof. H. E. T. Haultain; Prof. F C. Dyer; Prof. J. T. King.

SECOND ROW: R. Campbell; R. H. Junker; W. H. Barber; W. C. Irvin; W. T. Turrall; R. B. Adair; A. W. Jacob; V. Zachanko; J. L. Gartshore; Mr. J. Anderson.

THIRD ROW: J. D. McKichan; C. H. Knight; J. A. Wilson; A. Smith; J. L. Watts; J. C. Stavert; K. H. J. Clarke; L. E. Cupp; G. O. Loach; T. E. Norman; J. A. McArthur.

FOURTH ROW: A. A. Franke; R. S. Buntin; B. J. F. Hamilton; D. P. Scott; C. E. Burnett; P. C. Carter; C. W. Farrar; G. A. F. Jeffs.

Mining and Metallurgical Club

The Club has again been blessed with that same spirit and co-operation to which the success in past years can be attributed. Every function has been well supported and we believe that the high standard set in previous years has been maintained.

This year we were most fortunate in obtaining Mr. Fraser Reid, General Manager of the Howey Gold Mines, as our Honourary Chairman. Mr. Reid, a graduate of Queen's, devoted a great deal of time in the interests of the club and his advice was appreciated by the executive.

The activities of the year commenced on October 4th when we held our Freshmen Smoker in Hart House. On this occasion we welcomed into the Club in the traditional manner the sixty odd "frosh." Entertainment, which proved most amusing, was provided by the freshmen, after which refreshments were served in the Great Hall.

The inaugural dinner was held during the first week of December at the Engineers' Club. At this function our Honourary Chairman, Mr. Reid, was formally introduced to the Club members. Mr. Reid, being our guest speaker, gave a very interesting talk on "Milling in Cobalt." The attendance at this dinner showed the interest the members take in Club affairs as a new record was established with 115 present.

On the afternoon of December 7th, the members of the Club were the guests of the Toronto Branch of the Association of Women of the Mining Industry, at a Tea Dance held at Coles, College Street. This was a most enjoyable affair and appreciated by everyone present.

The Annual "Miners and Metallurgists At-Home" was the next social affair held by the Club. On January 16th, at Hunt's Savarin restaurant, seventy-five couples made merry to the rhythmic strains of Eddie Strouds' music. Everyone present had a most enjoyable time and this party is one that will be remembered for many a day.

On February 12th, the second club dinner was held at the Engineers' Club. On this occasion we listened to an interesting talk by Mr. Gilbert LaBine, Vice-President of Eldorado Gold Mines, who spoke on his own experiences and mining conditions in Great Bear Lake District. This meeting was well attended and thoroughly enjoyed by all.

Members of the Toronto Branch of the C.I.M.M. were hosts at a dinner given to the Graduating Class at the King Edward Hotel on February 27th. The meeting was one at which students representing Queen's and Toronto presented papers. As a result of the splendid work in preparing very interesting papers, we wish to congratulate Messrs. Adair, Clarke and Irvin.

The final meeting of the year was an affair we feel will go down in history. The Club members were the guest of Mr. Reid our present

Honourary Chairman and Messrs. Bryce, Kee, Williams, MacDonald, Neilly, Bateman, Nicholls and Errington, men who have held this position in past years. A number of other men from the profession were present and many wise and witty remarks were heard from those present. Two features of the evening were the intermixing of the men of the industry with the students and a song by Professor Guess. In the opinion of everyone present it finished off a good year with a bang.

At this opportunity the executive would like to express their appreciation to everyone who has co-operated to make this year a success. To the Faculty Staff we are greatly indebted for the interest they have shown in our affairs. We also wish to thank the many Toronto mining men for the way they supported our meetings and spoke to us. The undergraduate members have given their loyal support on every occasion without which of course we could not have hoped to succeed.

For the coming year we feel sure that Don Schmitt, your new Chairman, and his executive will be well able to carry on the affairs of the Club in a successful manner.

We of the graduating class, wish them the best of success for the future.

William T. Turrall,
Chairman.

D.E.G Schmitt
Sect.-Treas
Fraser D. Reid
Hon. Chairman
W.T. Turrall
Chairman
J.C. Stavert
Vice Chairman
J.L. Gartshore
4th. Year Miners
MINING AND METALLURGICAL CLUB EXECUTIVE
Faculty of Applied Science and Engineering
UNIVERSITY OF TORONTO
1935 1936
P.E. Cavanagh
3rd Year Metallurgists
T.M Childerhose
3rd Year Miners
D.B. Ross
2nd. Year Miners
J.F.S. Bolton
1st. Year Miners
W.J.C. Lewis
1st. Year Metallurgists
A.K. Walton
2nd. Year Metallurgists

FOURTH YEAR MECHANICALS

BACK ROW: L. S. Lotimer; K. W. Smith; J. A. Chamberlin; R. L. Miller; W. G. H. Holt; L. E. Skelly; E. J. Langan; J. M. Gandier; R. B. McIntyre; E. R. Eaton; R. L. Campbell; J. T. West; G. E. Smith; H. A. Wilson; W. E. Ledingham; C. A. Miller.

THIRD ROW: C. L. Annis; J. C. Millson; J. H. Miller; R. R. Noyes; D. J. Falconer; K. C. MacLean; A. P. Deacon; W. A. Connor; C. E. Lewis.

SECOND ROW: J. H. Govan; R. W. Cowan; G. A. Aitken; J. V. Kurtz; F. Krailo; T. S. Bartlett; E. R. Briggs; B. S. Wood; J. J. Vince; J. B. Treloar; J. W. Vila; R. S. Scrivener; M. L. Sherwood.

FRONT ROW: W. M. Lawrason; W. F. Taylor; Mr. R. C. Wiren; Prof. W. G. McIntosh; Prof. R. Taylor; Prof. R. W. Angus; Prof. E. A. Allcut; R. G. Gillespie; C. G. Campbell.

ABSENT: A. L. Rubinoff.

The Mechanical Club

The Mechanical Club has now completed eight years of successful operation as an independent club. It was originally a part of the Mechanical and Electrical Club as formed in 1907.

This year, the club got off to a fine start on October 4th, with a well attended smoker in Hart House. Our honourary chairman and the head of our department, Professor R. W. Angus, gave a very interesting talk on "Recent Hydraulic Developments in Europe." Pie and coffee brought this meeting to a close.

The next club activities were the third and fourth year trips, which were held on October 25. The fourth year men visited power plants at Queenston and Niagara Falls, N.Y. The third year students spent the day in Hamilton looking over the plants of the Steel Company of Canada and Westinghouse.

On November 12, the second smoker was held in the Music Room at Hart House. Mr. M. J. C. Lazier gave an interesting and instructive talk on the principles of "Design."

The club's annual dance was held at Ellen Bradley's Grill on January 15 as a pleasant method of relaxing after the Christmas exams. Known as the "Lab" party, it met with real success.

Hart House was again the scene of a club smoker on February 6. At this meeting, sound pictures of the "New Canadian Home" were shown and discussed by Mr. Milligan of the Piggott Construction Company, Hamilton. This meeting was featured by a lively student discussion.

The second year trip was held on February 10, to the Goodyear tire plant in New Toronto. This proved to be a well conducted and very instructive tour.

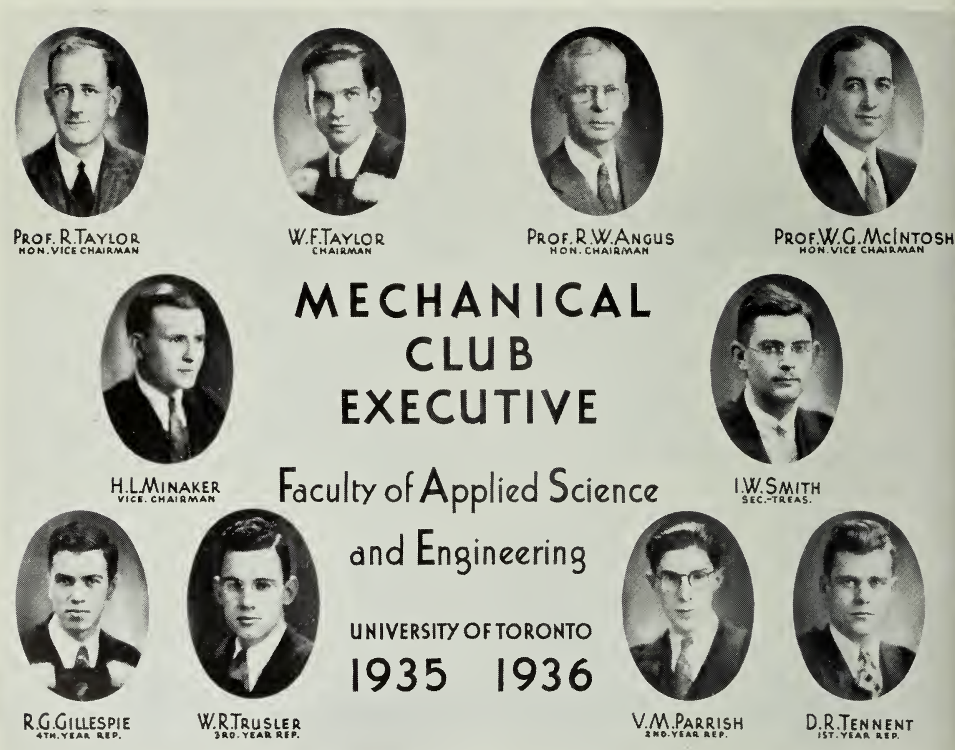
The final function of the year was the annual dinner, which was held at the Engineers' Club on February 26. Mr. H. Taylor of the Canadian National Carbon Company gave a fine talk on a new and important subject "Job Analysis." A few witty remarks by Professor Angus, the presenting of a Rolls Razor to Bob McIntyre, Massey Fellowship winner, and the cherrywood pipes were other features of an enjoyable evening.

A popular innovation this year was the Mechanical Club pin, designed by Mr. S. C. D. Lawson. This was made available to fourth year men only and met with hearty response.

I wish to thank all the members of the club for their support throughout the past season. Those who helped with the sing-songs and other details are especially mentioned.

May next year's club, under the guidance of Ralph Trusler, meet with the very best success.

W. Franklin Taylor,
Chairman.


PROF. R. TAYLOR
HON. VICE CHAIRMAN
W. F. TAYLOR
CHAIRMAN
PROF. R. W. ANGUS
HON. CHAIRMAN
PROF. W. G. McINTOSH
HON. VICE CHAIRMAN
MECHANICAL
CLUB
EXECUTIVE
Faculty of Applied Science
and Engineering
UNIVERSITY OF TORONTO
1935 1936
H. L. MINAKER
VICE. CHAIRMAN
I. W. SMITH
SEC.-TREAS.
R. G. GILLESPIE
4TH. YEAR REP.
W. R. TRUSLER
3RD. YEAR REP.
V. M. PARRISH
2ND. YEAR REP.
D. R. TENNENT
1ST. YEAR REP.

L.G. Mather
SEC.-TREAS.

F.A. Fleming
CHAIRMAN

Prof. T.R. Rosebrugh
HON. CHAIRMAN

W.J. King
VICE CHAIRMAN

G.W.N. Fitzgerald
4TH. YEAR REP.

ELECTRICAL CLUB EXECUTIVE

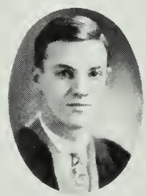
Faculty of Applied Science and Engineering

UNIVERSITY OF TORONTO

1935 1936

J.C. Wilson
2ND. YEAR REP.

H.L. Tipple
3RD. YEAR REP.



W.W. Rapsey
1ST. YEAR REP.

Electrical Club

As I squat with pen in hand, I wonder if the shiver that goes up my back is from the icy blasts outside the Engineering Society Office, or the approaching termination of our academic careers with attendant examinations. All of which means, that once more the Club's activities are drawing to a close and in accordance with an old established custom, we must annotate them for posterity.

With a view to better acquainting the Club members with one another, the Banquet this year was held early in the School term. "The geniality of Mr. H. W. Tate of the T.T.C. and the virtuosity of maestro McMullen on the ivories, combined with the warm dignity of the Engineer's Club to make for an outstanding Dinner."

Next in line was the annual trip to the Niagara district (and all points west) and after an instructive day and hilarious evening, the bus driver rounded up the last of the lads and started for home.

In December, C. Wilson Woodside gave the Club an intensely human talk, illustrated with some really wonderful slides, of his sojourn in Russia and other points. Mr. Woodside recently joined the Benedicts and is touring Western Canada on a lecture tour for the Canadian Club.

With the boys returning from the Christmas holidays with lots of money and energy, the Club held its Dinner-Dance at Diana Sweets early in January. Without sacrificing the quality of other Electrical Club Dinner Dances, this year's party was held at a lower cost than ever before. In fact, it was so good the lads went home talking to themselves (or was that the reason).

Although originally scheduled to speak for three quarters of an hour, Dean Mitchell, the next guest speaker of the Club, kept those present sitting on the edges of their seats for about two hours. For a long time, people had been trying to get the Dean to "open up" on his experiences in the Secret Service during the Great War, and when the Electricals persuaded him to do so, a story was told that was unique in the annals of club smokers.

Mr. de F. Bayly concluded the year's activities with another of his much-anticipated and riotous talks. This year it was on "Police Radio." For those present we say: "We told you Professor Bayly would be a knock-out," and for those that were not: "Too bad. You missed the best smoker in a long time. Be sure to get out next year."

F. A. FLEMING,

Chairman.

FOURTH YEAR ELECTRICALS

BACK ROW: C. A. Ehgoetz; A. W. LeWarne; F. M. Dawson; N. J. Robinson; A. B. C. Stothart; W. J. Sealy; J. A. I. Kidd; A. F. W. McLaughlin; A. M. Weir; H. M. Carioni.

THIRD ROW: B. I. McCall; R. A. Thompson; H. B. Charters; R. A. Boyle; R. F. Cline; S. R. Walkinshaw; M. P. Johnson; D. A. Aitken; H. J. Middleton.

SECOND ROW: D. B. Bruce; J. E. M. Honey; H. Young; G. W. N. Fitzgerald; W. B. Morrison; L. D. L. Clement; D. J. Pepper; A. U. Houle; S. H. Galloway.

FRONT ROW: Mr. R. J. Brown; Prof. B. de F. Bayly; Prof. T. R. Rosebrugh; Prof. H. W. Price; Prof. A. R. Zimmer; Prof. V. G. Smith; Mr. M. Ward; F. A. Fleming.

FOURTH YEAR CHEMICALS

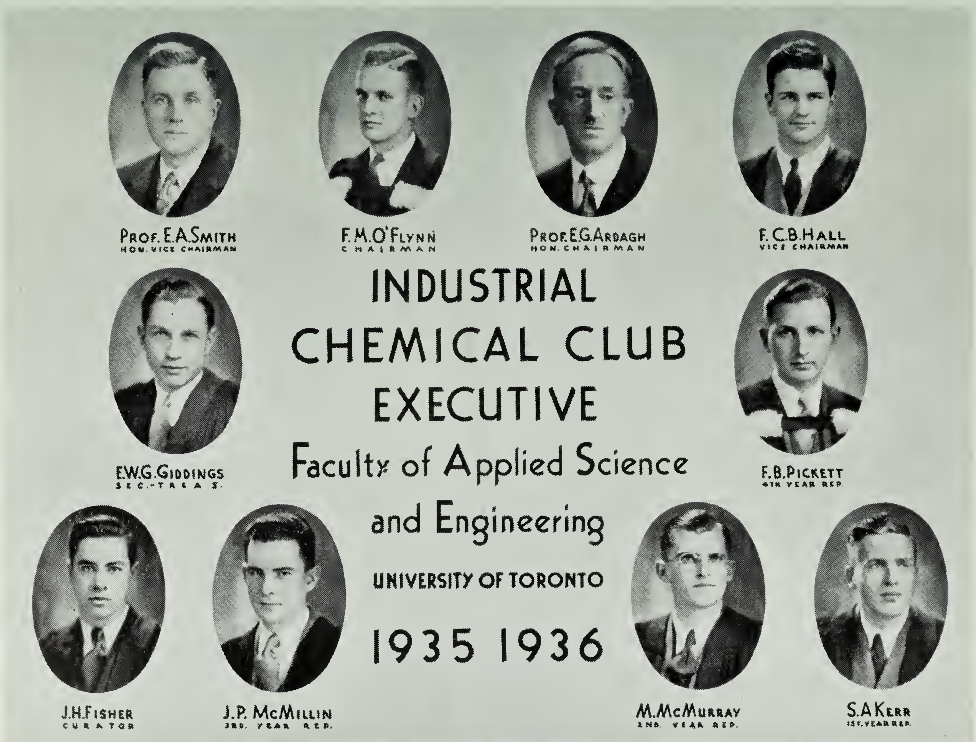
BACK ROW: T. W. Winter; S. M. Rothman; L. G. Webber; J. N. Robinson; J. C. Williams; H. J. G. Carter; H. J. Ostrowski; J. E. Pepall.

FOURTH ROW: P. O. Jeffrey; H. F. Wiffen; E. A. Dorfman; S. A. Finlay; A. R. Thompson; W. R. Stickney; T. R. Press; E. G. F. Rosengren; W. R. Tutton; D. C. Barber; H. M. Kerr.

THIRD ROW: A. H. Blackmore; R. L. Broad; J. A. Rolls; K. Patrick; W. J. Dennis; S. E. Lewis; W. R. Keating.

SECOND ROW: E. A. Bradley; R. G. Curlew; A. C. Elliot; I. L. Shopiro; H. T. Conn; H. A. Proctor; Miss A. M. Pescott; H. W. Rawlings; A. G. Osborne; E. G. Kearney; R. P. Bigger; R. Grant; J. C. Burrows.

FRONT ROW: R. V. Welch; G. R. Davidson; F. M. O'Flynn; Prof. E. G. R. Ardagh; Dr. M. C. Boswell; J. K. W. Ferguson; Dr. R. R. McLaughlin; F. B. Pickett.


Prof. E.A.Smith
Hon. Vice Chairman
F.M.O'Flynn
Chairman
Prof. E.G.Ardagh
Hon. Chairman
F.C.B.Hall
Vice Chairman
INDUSTRIAL
CHEMICAL CLUB
EXECUTIVE
Faculty of Applied Science
and Engineering
UNIVERSITY OF TORONTO
1935 1936
E.W.G.Giddings
Sec.-Treas.
F.B.Pickett
4th Year Rep.
J.H.Fisher
Curator
J.P. McMillin
3rd. Year Rep.
M.McMurray
2nd. Year Rep.
S.A.Kerr
1st. Year Rep.

The Industrial Chemical Club

The club has been very active this year and many interesting meetings have been held, generally well attended.

Our first function was a smoker held in Hart House in October. Professor L. J. Rogers spoke to us and as usual gave us a most interesting and entertaining address on his many experiences in the sphere of criminology. This meeting was a very fine start to the year's activities and over one hundred and fifty men were present.

The customary trip to the Niagara Peninusula took place in early November and two interesting plants were visited, the Alliance Paper Mills in Merritton and the Carborundum Company, Niagara Falls, N.Y. The trip continued on to Buffalo for the benefit of the pleasure seekers and many picturesque spots were visited, including the local constabulary.

A second smoker was held late in November at which Mr. McCutcheon and Mr. Clark of Lever Bros. gave us an instructive talk on the manufacture of soap, with emphasis laid on the oils and perfumes used in the process.

Dr. A. E. R. Westman of the Ontario Research Foundation spoke at our last smoker of the fall term and outlined five different methods of attacking research problems, illustrated by examples from his own experience.

The winter term opened with the club dance under the kind patronage of Mrs. R. R. McLaughlin and Mrs. E. G. R. Ardagh. Due to rather poor arranging on the part of the chairman things were not all that they should have been, but I think everyone there enjoyed themselves nevertheless.

A smoker was held in February and Ron Gorrie, last year's club chairman, who is working at the Canada Printing Ink Company, was our speaker. He gave us a most interesting and enlightening talk on the chemistry of printing inks, illustrated with slides.

Our last function of the year was a dinner at the Engineer's Club, at which Professor T. R. Loudon spoke on "Present Day Development in Aeronautics."

This rounds out our year's activities and the chairman would like to thank the members of the executive for their co-operation and assistance throughout the year, and to wish the club further success next year under your new chairman, Knox Beardmore.

F. M. O'FLYNN,
Chairman.

FIFTH YEAR ARCHITECTS

BACK ROW: D. C. Grubbe; Prof. H. H. Madill; Prof. H. J. Burden; Mr. Mackenzie Waters; Prof. E. A. Arthur; Mr. W. R. Carswell.

FRONT ROW: R. A. D. Berwick; J. E. A. Smith; H. D. Morgan; R. J. K. Barker; A. R. Prack; I. M. Saunders.

Architectural Club

Even a brief review would indicate that the Architectural Club has had a very active year.

Of course our first meeting was the Annual Dinner, which taxed the capacity of the Good Companions to the very limit. Informality was the keynote of the evening, entertainment being supplied by the Frosh in traditional manner, supplemented by a few numbers from the Fourth Year Quartet. All the members of our Staff were present, as well as quite a number of our recent graduates, making the attendance surprisingly good. Elbow-room was at a premium. Our Honorary Chairman, Mr. Dyce Saunders, was introduced to the Club, and made a brief address.

During the Fall Term the Club met twice more, when we were addressed by Mr. L. A. C. Panton, O.S.A. Art Director of Western Technical School, and by Mr. Douglas McRae, a former graduate of the department.

In January came the Big Event. After several weeks of preparation, in which practically the whole School took part, the Second Mauvais Arts came to pass. Suppose we confine our remarks to a quotation from Parkin's report of last year—"When better parties are held the Architects will hold them!" Judging simply from reports in the local press, this will soon become an axiom. Most of us are already looking forward to next year's.

It would be appropriate here to express our appreciation to our professors for their great interest in the Club, and their support of all our Club activities. Professor Madill and Professor Arthur made many helpful suggestions, and through their co-operation several interesting speakers were obtained for Club meetings during the Easter Term.

Mr. James Govan very kindly gave us his time on two occasions, discussing the possibilities of insulation and the technique of its use. We were addressed by Mr. Guy Mitchell, of the Robert Simpson Company, who spoke on the uses of modern fabrics in interior design, and Mr. S. H. Maw on the problems met with in the planning of departmental stores. At the Semi-Centennial Convention our speaker was Mr. J. H. Craig, of Craig and Madill, who brought to our attention the important effects of real estate taxation on the construction industry. At the last meeting of the year we heard a very instructive talk on modern materials from Mr. J. M. Oxley, of Chapman and Oxley.

All our activities were well supported, a fine spirit being evident throughout the School.

In conclusion, we are glad to note that the Guiding Hand next year will be that of Freddie Smith, whose ability and enthusiasm insures the Architectural Club a very successful season.

KENT BARKER,
Chairman.

W. H. Birmingham
SECRETARY

F. N. Smith
VICE CHAIRMAN

R. J. K. Barker
CHAIRMAN

Dyce C. Saunders
HON. CHAIRMAN

A. R. Prack
5TH. YEAR REP

ARCHITECTURAL CLUB EXECUTIVE

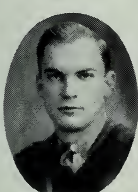
Faculty of Applied Science and Engineering

UNIVERSITY OF TORONTO

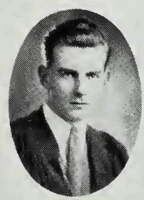
1935 1936

Miss A. K. Gauthier
4TH. YEAR REP.

A. H. Armstrong
3RD. YEAR REP



A. B. Scott
2ND. YEAR REP



E. H. Noakes
1ST. YEAR REP

A.R.THOMPSON
VICE CHAIRMAN

PROF. W.J.T. WRIGHT
HON. CHAIRMAN

C.C.HOAG
CHAIRMAN

F.S.HUTTON
SEC.-TREAS.

R.H.SELF
4TH. YEAR REP.

DEBATING CLUB EXECUTIVE

Faculty of Applied Science and Engineering

UNIVERSITY OF TORONTO

1935 1936

W.A.H.LOWE
3RD. YEAR REP.

M.A.THOMPSON
2ND. YEAR REP.

H.deV.PARTRIDGE
1ST. YEAR REP.

Debating Club

This year the inaugural meeting of the Debating Club was marked by the largest attendance of any meeting in the history of the club. Mr. Escott Reid of the Canadian Institute of International Affairs lead an interesting discussion on Father Coughlin's attacks upon Great Britain and the British foreign policy.

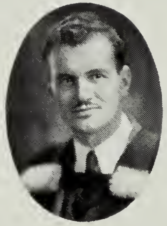
After several closely contested debates, first year, represented by Messrs. Partridge and Reade, carried off the Segsworth Trophy and were presented with silver loving cups emblematic of their Faculty Championship. This latter presentation was an innovation introduced for the first time this year.

From a host of contestants, speaking on a variety of subjects ranging from humorous topics, such as "The Morning After the Night Before" to weighty discourses upon "Perpetual Motion," J. E. Boyd emerged as the impromptu speaking champion—winning a five dollar cash prize and holding the public speaking cup for the next year. Messrs. Fensom and Cook finished second and third respectively in the contest.

The success of the Debating Club cannot be measured by the numbers attending its meeting but rather by the enthusiasm and number of the actual participants in the debates and discussions. In the latter respect it is the sincere belief of the club executive that the past year was unusually successful.

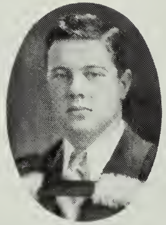
To next year's chairman-elect the retiring chairman can wish for no greater fortune than that his executive give him as loyal and genuinely enthusiastic support as has the executive of the past year.

Chuck Hoag,
Chairman.



R.A. Boyle
COUNCILLOR

C.C. Hoag
VICE-PRESIDENT



R.B. McIntyre
PRESIDENT

W.M. Lawrason
VICE-PRESIDENT

C.L. Annis
SECRETARY-TREASURER

E.R. Eaton
COUNCILLOR

PERMANENT EXECUTIVE OF THE CLASS OF 3T6

Faculty of Applied Science and Engineering

UNIVERSITY OF TORONTO

1935 1936

F.M. O'Flynn
COUNCILLOR

A.W. Jacob
COUNCILLOR

W.F. Taylor
COUNCILLOR

Message of Permanent Executive 3T6

Let the members of 3T6 now look in retrospect at the four years which they have spent in the search for knowledge, wisdom and truth, here at the S. P. S. Co-incident with the founding of 3T6 in 1932, came the birth of a class spirit which strengthened itself year by year as we all worked and played together. Through lectures, labs, dinners, initiations, games, smokers, dances, parties and elections, our 3T6 has carried itself well as an undergraduate body.

It is now our concern to maintain 3T6 as an Alumni body. This will not be difficult. As individual "fellows of 3T6", all that is required of you is your co-operation. Send us news of yourself and your family at frequent intervals. Keep in touch with your nearest executive representative. Send in your suggestions and ideas. Come to rugby games and especially the re-unions. Read the University of Toronto Monthly for news of the fellows you used to pal around with at the School.

By these means, the voice of 3T6 will continue to be heard.

Remember our permanent executive—they are always ready to work in your interest, and their purpose will be mainly to serve as a clearing house for your ideas. To refresh your memory we give you a list of the members of the executive with their home addresses.

May we now leave you with the best wishes for all that is to come.

3T6 Permanent Executive

President—R. B. McIntyre, 309 Lauder Avenue, KE. 4989

Vice-Presidents—W. M. Lawrason, 40 Lorne Ave., Hamilton
C. C. Hoag, 27 Quebec Avenue, JU. 6689

Secretary-Treasurer—C. L. Annis, Highland Creek

Councillors—R. A. Boyle, 49 Avenue Road, MI. 3033
E. R. Eaton, Apt. 406, 2 Sultan St., KI. 7272
A. W. Jacob, 18 Munro Park Ave., HO. 4267
F. M. O'Flynn, St. Catharines
W. F. Taylor, Malton, Ontario.

C.C.HOAG
CIVIL REP.
C.A.MILLER
SEC'Y.-TREAS.
G.E.SMITH
PRESIDENT
DEAN C.H.MITCHELL
HON. PRESIDENT
G.O.LOACH
VICE PRESIDENT
J.L.GARTSHORE
M. AND M. REP.
FOURTH YEAR
EXECUTIVE
Faculty of Applied Science
and Engineering
UNIVERSITY OF TORONTO
1935 1936
W.H.BARBER
ATHLETIC REP.
R.H.SELF
DEBATING REP.
A.R.PRACK
ARCHITECTURAL REP.
R.G.GILLESPIE
MECHANICAL REP.
F.B.PICKETT
CHEMICAL REP.
G.W.N.FITZGERALD
ELECTRICAL REP.

Class of 3T6

In the fall of 1932 the time-worn walls of the Little Red Schoolhouse were graced with 265 embryo engineers. However, it was not long before the Sophmores put us through the "mill," and we came out toughened schoolmen. Then under the direction of "Whitey" Irvin, "Tony" DeMaio, and "Cromp" Lewis, we entertained the Sophmores, (and most of the Juniors and Seniors) at the famous Soph-Frosh dance.

It was in our second year the bad practice of crashing downtown theatres was brought to an abrupt end when we were caught in Shea's. The remainder of our social activities were perfectly legitimate under the leadership of our executive Bob McIntyre, Lorne Campbell and George Maynard.

Graduates tell us that third year is the hardest in our life. In spite of the work we found time to go to two dances arranged by George Aitken, Lorne Campbell and Jerry Smith.

The fly in our spirits in Fourth Year was the thesis. For some it was due near the first of the year, for others near the end. The activities this year were guided by Jerry Smith, Jerry Loach, and Art Miller. The outstanding events for the year were our Fall Dance at the Boulevard Club, and then the Alumni Dinner, in honour of the Graduating Year. This dinner is a grand idea and a number of us made contacts there that may change the course of our lives. We climaxed our social activities with the Graduation Ball, and pleasant memories of it will long linger with us.

And now we have elected our Permanent Executive, who will keep in touch with all members so that the class of 3T6 will pass down through the years as the same loyal unit they have been in the past. "Bob McIntyre" and his executive are already organizing the year. Give them your support.

GERALD E. SMITH,
President.

Class of 3T7

Here we are at the end of another session, and once again, it is time to review the accomplishments of the year.

Third year, on account of its very full time table, is traditionally a hard year in which to maintain class spirit that has been developed during the first two years in School. Yet we can say, with assurance, that the men of 3T7, in sport, in executive work, and in social activities, have, at the very least, held their own with other groups in the School. These accomplishments are too numerous to mention here, and at any rate are known to most of you.

We had a short hockey series during the spring session. This year only three departments found time to enter the games—Mechanical, Chemical, and Electricals. The latter team defeated all comers, and at press-time were debating whether or not to enter the Allan Cup playdowns

Many of you will know that during the year we have been working towards a reform in one of the courses of the Curriculum. As a result of this work we hope succeeding years will look on the Class of 3T7 as the benefactor of them all.

We had the first social function in School this year, that enjoyable affair at the Boulevard Club, on October 23. After this event the Executive decided that, during the remainder of the year, two smaller parties would be more desirable than one elaborate affair—thereby allowing two breaks instead of one in a very strenuous session. The first of these was held on December 12, the second on March 10, both at the Silver Slipper. Judging by the festive spirit shown by all of you at each affair, we believe you approve the course followed.

The financial position of the class is admirable; we have securities and a current account totalling over two hundred dollars.

You have elected a fine executive for our graduation year. We express gratitude for the co-operation you have given us during this session, and urge the same whole-hearted support for the new executive: Clay Hall, Bill Arison and Cliff Lumbers. Let 3T7 make history in graduation years!

And now, good luck to all of you during April, and a good job during the summer.

J. V. LEWORTHY,

President.

Class of 3T8

Towards the end of September, 1935, the class of 3T8 came back to "School" 170 strong and proceeded to show the freshmen around. A few weeks later, the class held a reception for the freshmen on October 21, at Hart House. A new type of reception was held with some success, although it did not go off quite according to plans,— the best laid plans of mice and men—

The freshmen returned the compliment of November 1 at the Royal York Hotel, when 3T8—3T9 hostilities ended in the big dance of the year, the Soph-Frosh.

Before School broke up for the Christmas holidays a year party was held at Hunt's Savarin. The holidays then afforded an opportunity of preparing for mid-terms.

Mid-terms over, the busy Easter term commenced and such events as School Nite, School At-Home and the 50th Anniversary were functions enjoyed by 3T8 along with the rest of "School."

On March 5, the final year party was held at the Silver Slipper, when one hundred couples danced to the syncopating rhythm of Nels Kelly and his orchestra.

After these functions have all been paid up the class has something over one hundred dollars with which to carry on next year.

The class was well represented on the various teams in both inter-faculty and intercollegiate competition; in football, hockey, swimming and golf, to mention a few of these teams.

The class executive has appreciated the co-operation extended by members of the class and strongly recommend that you give the same support to the new executive under Dunc Ross.

With best wishes for success in your exams and an enjoyable and profitable summer, I am

JACK R. MILLER,
President 3T8.

Class of 3T9

"Veni, Vidi, Vici!" (At least that's what they hope, exam results aren't out yet.) With an idea towards becoming educated, two hundred and twenty-five odd Freshmen signed on for four years. To their regret or pleasure they were stampeded on the first day. And so on for one month, one hundred morons called "Sophmores" tried to make mince out of two hundred odd men. Well, their cause was predestined to failure, and except for ambushes and treachery they got nowhere.

On Friday, November the first, the famed "Soph-Frosh" dance was held at the Royal York. There, until three ante meridien the Soph and Frosh boistered and gambolled. (Our one Freshette of the year proved herself a true S.P S.-er by sticking till the last note was played.)

Due to the passing of His Majesty, King George V, our second dance of the year was cancelled. So on Thursday, February 27th, our last year dance was held at the Boulevard Club. The funds from the cancelled dance were thrown in for this dance and aided in making it a real success. So much for the social of 3T9.

As far as sports go, 3T9 did its part well. Certain members of the year aided the S.P.S. B.W. and F. Team and at the time of writing the Junior Basketball team is on its way to laurels. Here's to them. In football, tennis and waterpolo other members proved they were worth their weight in gold to the Athletic Association.

To come down to the matter of brains, nothing can be said as yet, except "watch 3T9."

L. T. Redman,

President, 3T9.

School Elections

Monday morning, most of us came to School fully recovered from the Convention and At-Home of the previous Friday.

There, on the side of the stairs in the hall was a long list of offices open for nominations. All day Monday and Tuesday nominations poured in, and the names were promptly posted on the wall. Between lectures everyone came over to see who else was running. By Tuesday night 12.21 per cent. of the Schoolmen had their names on that list.

The General Meeting of the Engineering Society on Wednesday was crowded, with hilarious men, to hear the election speeches of the candidates. They were not disappointed.

Thursday morning campaigning started in earnest. Walls were covered with posters—choice morsels from Esquire—pick axes—and old tires. Candidates suddenly knew everybody's name.

At twelve o'clock on Friday, the call of our "Big Bertha" to come out and parade to Hart House was greater than the invitations of the staff to stay in stuffy rooms and have our heads stuffed. With pipers in the lead we took Hart House by storm. After lunch we met in the common rooms, and woe to any Arts man or Med that so much as looked in.

Then the parade back, the attempt on the Medical building, and the rush on the polling stations. Candidates were thick around the polling stations, shouting, forcing blotters and favours on the voters, shoving signs in their faces and trying to guide their hands correctly on the ballots. By 2.30 most of the fun was over, and everyone adjourned to downtown movies.

By 7:00 o'clock, after hours of labour, the results were ready, and all loyal school men met in Hart House, to see boxing and wrestling bouts and let a magician put it over on us. Later in the Great Hall, with our stomachs full, we watched the successful candidates being announced.

Each successful candidate took his pals off to celebrate, and the sun was rising before all was quiet at the Residences.

GERALD E. SMITH,
Chief Returning Officer.

School Dinner, 1935

If the annual School Dinner were just a mediocre affair, improving on previous performances would be comparatively easy. School Dinner committee meetings might then be quiet, gentlemanly gatherings in place of the noisy brawls waged behind the swinging door of the Society office.

Every year, however, seems to produce a new committee with greater ambitions, and every year the School Dinner seems to be better than its predecessor, good as that may have been.

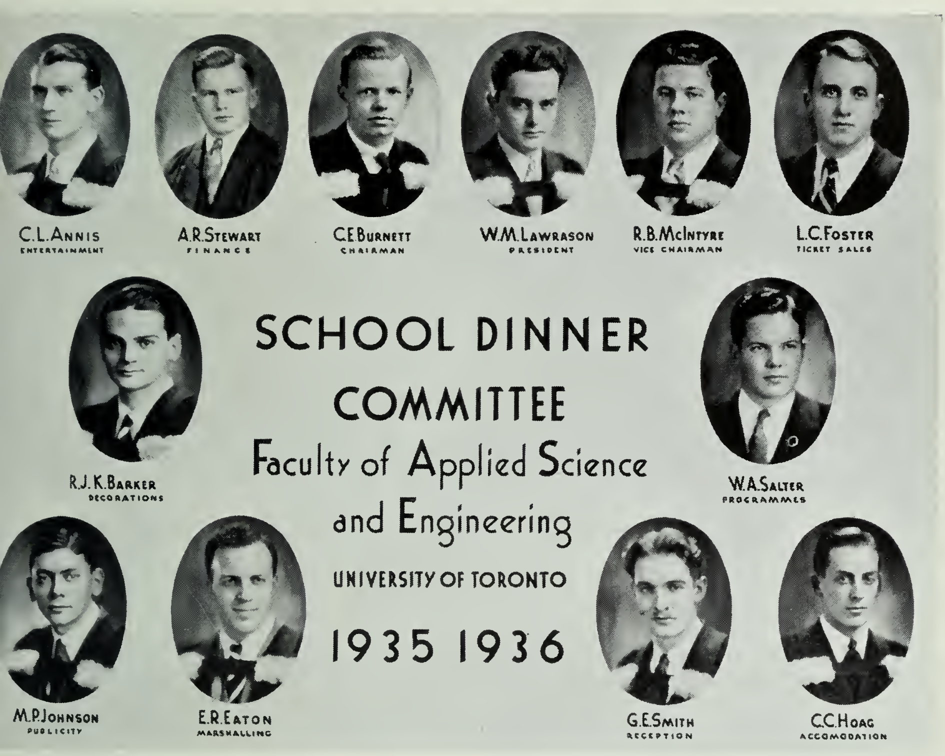
On the night of Wednesday, November 20th, 1935, Hart House was the scene of the forty-sixth annual School Dinner. The guest speaker was Mr. B. K. Sandwell, economist, political writer and managing editor of "Saturday Night."

Many surprising things happened, the most remarkable being the revelation, at the hands of a loose convict, that one of the waitresses was a Schoolman. The convict was dressed in baggy, homespun flannel with 1½-inch horizontal stripes, giving his whole ensemble a strikingly sporty effect. The waitress-Schoolman appeared in a ravishing wig of ox-blood red, neat lace collar and cuffs, and a white pinny. Brogues completed his outfit.

Vital Statistics of the 46th Annual School Dinner:—

The actual dinner began with fresh, fruit cocktail and officially finished with good, honest coffee. The chairman was our able president, Bill Lawrason, and the toast to the University was replied to by the President, the Hon. and Rev. H. J. Cody. In responding to the toast to School, Dean Mitchell started a very amusing controversy with the guest speaker, Mr. Sandwell, by talking of his golf at Murray Bay. The address by Mr. Sandwell was thirty minutes long, and very, very good. The songs sung by the entire chorus of Schoolmen just before the speeches were: "There is a Tavern in the Town;" "On the Road to Mandalay;" and "Engineers' Drinking Song," (Opus No. 18). The "One Man Band" is Mr. Clair Rouse in ordinary life and sells radios at Eaton's College Street store in the daytime. The University Trio, also considered a success, consisted of the Jollisse brothers and John Bates, from Victoria and Emmanuel Colleges. Actually, the Dinner in general is remembered by Schoolmen as having been a great success and they look forward to its successor.

T. S. BARTLETT.


C.L.Annis
Entertainment
A.R.Stewart
Finance
C.E.Burnett
Chairman
W.M.Lawrason
President
R.B.McIntyre
Vice Chairman
L.C.Foster
Ticket Sales
R.J.K.Barker
Decorations
SCHOOL DINNER
COMMITTEE
Faculty of Applied Science
and Engineering
UNIVERSITY OF TORONTO
1935 1936
W.A.Salter
Programmes
M.P.Johnson
Publicity
E.R.Eaton
Marshalling
G.E.Smith
Reception
C.C.Hoag
Accomodation

School Nite

School Nite enjoys the reputation of being the most popular "Informal Night" on the campus. It is credited with the highest attendance of any social event on the campus.

On January 31st, 1936, our 14th School Nite was enjoyed by thousands of appreciative undergraduates. "Paradise Regained" was the highlight of the evening, and this revue clearly indicated the possibilities of the Schoolman's dramatic abilities. It was one of the most humorous plays ever presented in Hart House Theatre.

For those unable to obtain admission to the theatre, the Dolphinettes provided a colorful display in the pool. The popularity of this phase of the program was shown by the crowded galleries.

A delicious buffet supper was served in four sections in the Great Hall. The committee had arranged this detail so efficiently that everyone was comfortably accommodated.

The five orchestras which provided the rhythmic music kept the dancers enthralled all evening, until 2 a.m. arrived far too quickly.

During the evening School enjoyed the distinguished patronage of Mrs. H. J. Cody, Mrs. C. H. Mitchell, Mrs. J. T. King, Mrs. T. R. Loudon, Mrs. A. Wardell.

J. W. S. Vila.

Semi-Centennial Committee

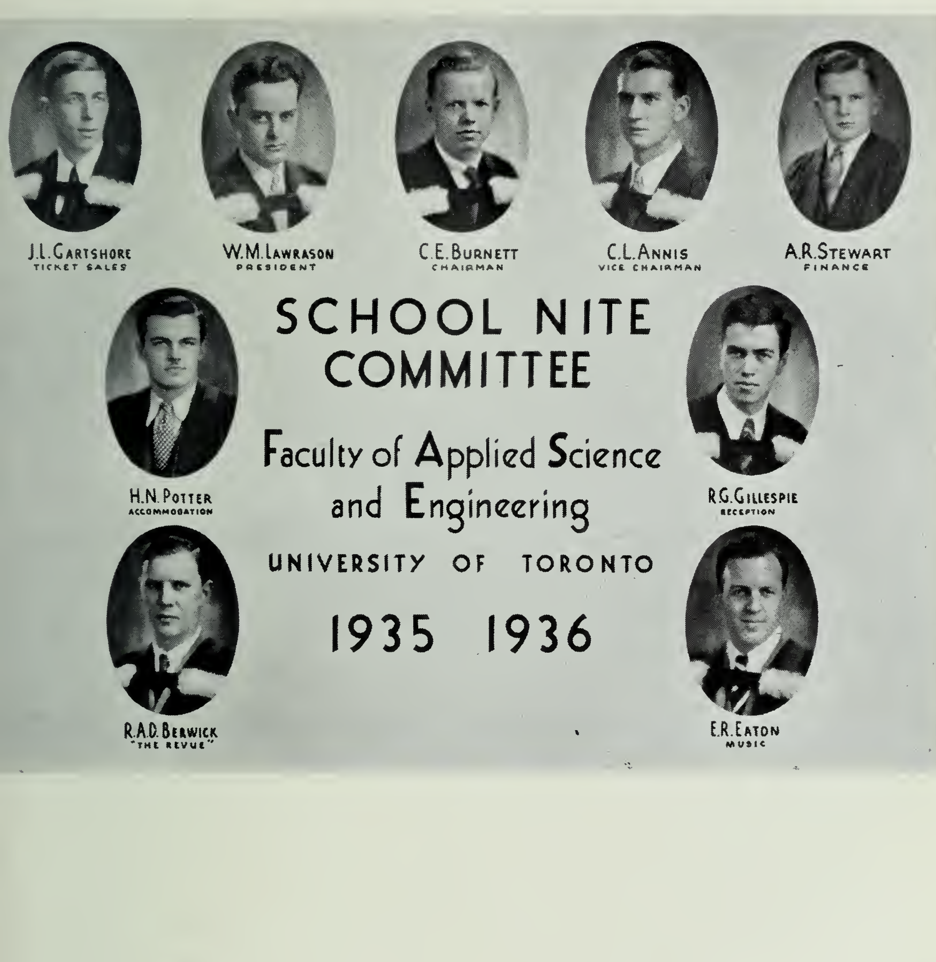
This year's Semi-Centennial celebrations will long be remembered as the greatest event ever undertaken by the Society.

Never before has there been such an exemplification of "School Spirit" as on Friday, February the twenty-first, nineteen hundred and thirty-six, when over a thousand members of the University of Toronto Engineering Society gathered at the Royal York Hotel to commemorate the founding of their Society. Distinguished men, eminent in the field of Engineering, travelled from distant points in both Canada and the United States to be present at the fiftieth anniversary of the oldest Engineering Society in Canada.

The preparatory work done by the committee was of necessity difficult because of the multiplicity of details involved in planning an event truly worthy of so significant an occasion. However, they feel more than repaid for their time and work by the culmination of their efforts in an Engineering Convention of unqualified success.

C. C. Hoag,

Chairman.


J.L. GARTSHORE
TICKET SALES
W.M. LAWRASON
PRESIDENT
C.E. BURNETT
CHAIRMAN
C.L. ANNIS
VICE CHAIRMAN
A.R. STEWART
FINANCE
SCHOOL NITE
COMMITTEE
Faculty of Applied Science
and Engineering
UNIVERSITY OF TORONTO
1935 1936
H.N. POTTER
ACCOMMODATION
R.G. GILLESPIE
RECEPTION
R.A.D. BERWICK
"THE REVUE"
E.R. EATON
MUSIC


C.E.BURNETT
VICE-PRESIDENT


W.T.TURRALL
RECEPTION


C.C.HOAG
CHAIRMAN


F.A.SWEET
VICE-CHAIRMAN


W.M.LAWRASON
PRESIDENT


R.G.WYKES
PUBLICITY

SEMI-CENTENNIAL COMMITTEE


H.N.POTTER
FINANCE

UNIVERSITY OF TORONTO
ENGINEERING SOCIETY

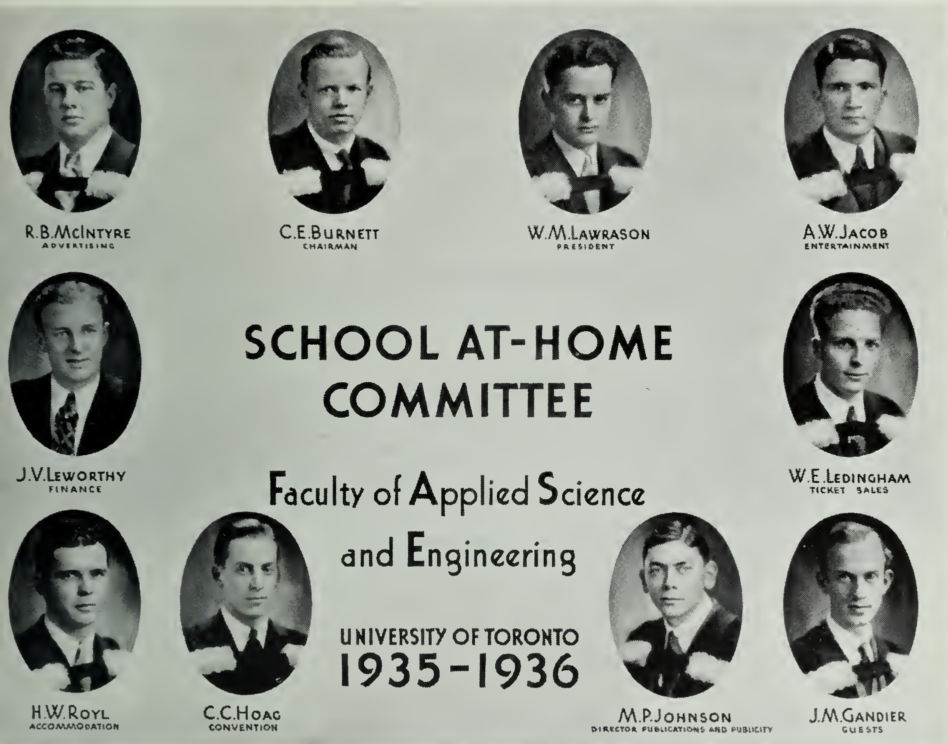
19 36


E.R.EATON
ENTERTAINMENT


W.E.BARNETT
PROGRAMME


J.T.WEST
ALUMNI-CONTACT


W.A.RAMSAY
ACCOMMODATION


R.B.McIntyre
ADVERTISING
C.E.Burnett
CHAIRMAN
W.M.Lawrason
PRESIDENT
A.W.Jacob
ENTERTAINMENT
SCHOOL AT-HOME
COMMITTEE
J.V.Leworthy
FINANCE
Faculty of Applied Science
and Engineering
W.E.Ledingham
TICKET SALES
UNIVERSITY OF TORONTO
1935-1936
H.W.Royl
ACCOMMODATION
C.C.Hoag
CONVENTION
M.P.Johnson
DIRECTOR PUBLICATIONS AND PUBLICITY
J.M.Gandier
GUESTS

School At-Home

After the absence of a year School At-Home again took place in a blaze of glory. Nothing could be more fitting than to have this event follow the Engineering Society's Semi-Centennial Celebrations.

One thousand people gaily dancing to scintillating rhythm until four-thirty a.m. made a night that will long be remembered. Never before did so many graduates and undergraduates throng an At-Home. Representatives of School returned from the far corners of the continent.

With decorations and lighting effects done in traditional School colours, the ballroom was one blaze of colour. Supper was served at midnight and here the tables were also decorated in blue, gold and white.

Those exotic, interpretive dancers, Wes and Lisa Adams, provided entertainment of the finest calibre that could be obtained.

One of the many guests present was Dr. T. K. Thomson, the founder of the Engineering Society. Patronesses who graced the dance with their presence were; Mrs. H. J. Cody, Mrs. C. H. Mitchell, Mrs. C. R. Young, Mrs. R. W. Angus, Mrs K. B. Jackson, Mrs. M. C. Boswell, Mrs. G. A. Guess.

C. E. Burnett,
Chairman.

Graduation Ball

"Eat, drink and be merry, for to-morrow you may graduate." One hundred and fifty men took our advice, got a beautiful girl, and landed out at the Royal York Hotel on Friday, March 6th, 1936, for the last, and best, fling of their college career.

For where is there a finer place to dance than the Banquet Hall of the Royal York Hotel, a perfect floor, palms, ferns, chesterfields, and soft strains by Fred Evis and his boys. To add to our pleasure our talented Fred Fleming and Miss Noyce did several special dances.

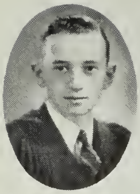
At midnight a superb supper was served in one end of the hall. Boxes of candy and little sharpening stones were given out as favours. By now every one was in the best of spirits and were singing their own songs to their own tunes, so Russ Eaton led a sing song, and also introduced the new song written by Clare Annis especially for the Grad Ball.

Then some danced and some gave the elevator men a ride, or did fairy dances in the higher parts of the hotel. When word spread around that the dance would go on to 3:30, and breakfast would be served at 6:30, great was the rejoicing.

Prestige was lent to the occasion by the presence of Mrs. C. H. Mitchell, Mrs. C. R. Young, Mrs. R. W. Angus, Mrs. H. H. Madill, Mrs. K. B. Jackson, Mrs. G. A. Guess, Mrs. W. G. McIntosh.

At 3:30 the music faded, and the last undergraduate dance was over.

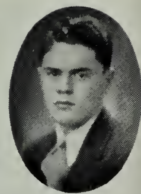
G. E. Smith.



L. Rosenblatt
SPORTOIKE

M.P. Johnson
DIRECTOR OF PUBLICATIONS AND PUBLICITY

W.E. Barnett
EDITOR



J. Kerr
ASSISTANT EDITOR

B. Chant
1ST. YEAR REP.

TOIKE OIKE STAFF

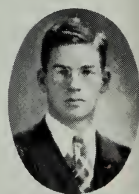
Faculty of Applied Science and Engineering

UNIVERSITY OF TORONTO

1935 1936

H. Wilson
2ND YEAR REP.

J. Boyd
4TH YEAR REP.



A.P. Hopkins
3RD. YEAR REP.

Toike Oike

Practically since the founding of the Engineering Society, the Toike Oike has been published as the official paper of that organization. Though the masthead announces the publication as "Every now and then," we might add for the benefit of those not familiar with "School," that this simple phrase merely means at every important event of the Red School House's social curriculum.

The Freshman and Initiation editions naturally deal in a very direct way with the "Frosh" and give them some fatherly advice regarding their health and happiness. School Dinner number announces the greatest stag event of the campus and is followed by the Christmas edition which draws the first term to a close. The following three editions mark the greatest events of all campus activities: firstly, the colourful School Nite; secondly, the formal School At-Home; and lastly, but in no meagre way, the Graduation Dance. The last copy of the year is the Election number in which candidates purchase small spaces to tell of their achievements and accomplishments of the past, and their promises for the future.

Besides giving very complete details regarding these various events, each copy includes a message from the Dean, the Sport Oike column and a very choice selection of jokes and short stories.


UNIVERSITY OF TORONTO
~ SURVEY CAMP ~
Civils 1935 Miners.

Gull Lake Survey Camp

On the fifteenth of August last, cars began to arrive at the University Survey Camp buildings on Gull Lake, and the air was filled with the sounds of greetings and merriment as arrivals met their classmates, and picked bunks to their taste and convenience. The murals and frescoes which adorn the building were the subject of much comment and admiration. To the casual listener it must have sounded rather like a convivial party in a church yard, as a common phrase would be: "There's old Bill Jones, remember Bill, don't you? He was a good old scout." The reference was to a neatly lettered sign to the effect that one Bill Jones, miner, of some year, had slept here.

Beginning the next day, the boys worked more or less consistently either at surveying, geologizing, drafting and calculating or the more difficult work of getting out of these jobs, for the next five weeks. We had good weather for swimming, and field work. A few of the hardier boys continued their before-breakfast swim to the bitter end, proving beyond doubt that comfort is only relative, and the added luxury of watching these boys climb into wet bathing suits, while we were warm in bed, was as good as an extra hour's sleep.

During the five weeks, we held two dances in the bunkhouse, well attended by the staff and our neighbours on the lake. These parties were pronounced by old timers as being up to standard in most respects, and, in the opinion of some, the boys were a little better in their behavior than usual. In return, the visitors invited us to social functions of various kinds across the lake, so that the nights were by no means lonely ones for most of the boys.

As was to be expected, the boys would go to Minden quite regularly, arriving back in fine condition, as a rule. Once, two of them arrived next morning on a raft which they had acquired in the village, and for want of better transportation, had guided it down the river to the lake, and so to the camp. It was a cold night, so they had a fire on the raft to keep warm, and the sight of this in the early morning coming in to dock is one of the memories of the camp which will stick with most of us. The following night, inspired by the idea, a big fire was built on the raft, and then towed out in the lake to burn.

The annual regatta was not held this year, because the majority of the boys were absent over Labour Day, and when planned for a later day, the weather proved fickle, and it was called off. Several good games of ball were played, with the final decision in favour of the miners. This may have been because there were twelve miners to choose from, and only ten civils.

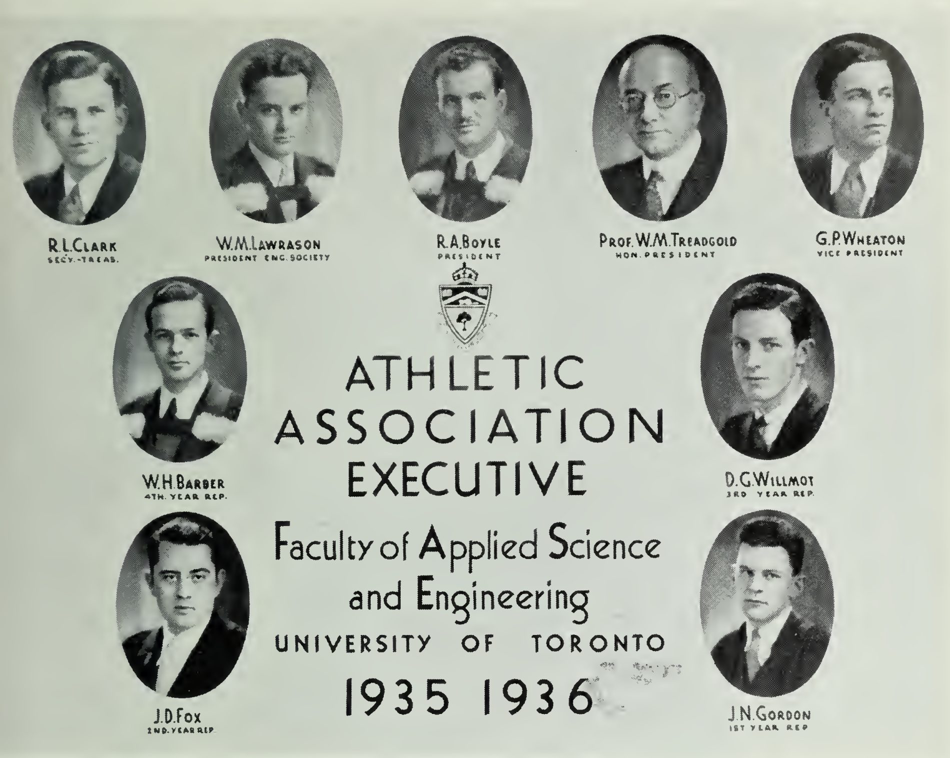
It was voted that some work be done on the property to commemorate our visit, and this work took the form of levelling the ground between the bunkhouse and Administrative Building. Some blasting of stumps

and rocks was required, which provided considerable entertainment for some of the later evenings. Unfortunately, the more drab work of levelling with shovel did not carry the same interest, but a few persevered, and the improvement is noticeable.

A sign was painted on the ceiling of the bunkhouse, as is the usual custom, and the names of the students attending this year were lettered in. What the sign may have lacked in true art, it made up in good engineering design and neatness.

After the final examination, it was with feelings of mingled relief and regret that the boys packed up to leave this most delightful institution in the University.

RALPH B. ADAIR.



S. P. S. Athletic Association

The S.P.S. Athletic Association is the governing body for all School teams entered in interfaculty competition.

School, always noted for spirited teams, enters two teams (Sr. & Jr.) yearly in rugby, lacrosse, volley ball, basketball, water polo, hockey, and baseball, and one team in soccer, B. W. & F., swimming, track and gym.

This year School won the Jr. Assault, and Senior Waterpolo. The hockey and basketball teams were in the play offs.

The Honourary President and active executives are elected each spring by the student body. Its object is to encourage Athletics and to co-operate with the University of Toronto Athletic Association.

R. A. Boyle,
President.

S.P.S. "T" HOLDERS

LEFT TO RIGHT: Jack Millson, Ron Allison, Russ Eaton, Pete McDonald.
ABSENT: Clare Annis, Dick Miller, Geo. Beard, Fred Smith.

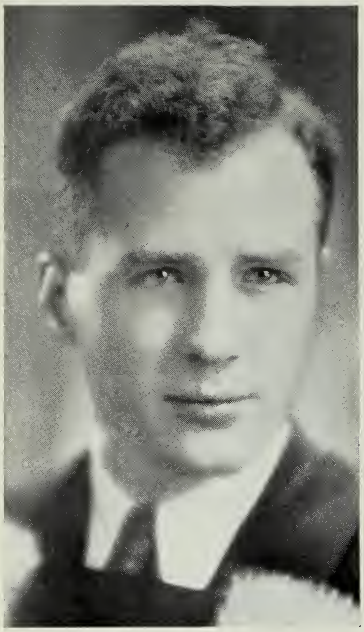
S.P.S. "S" HOLDERS

BACK ROW: Young, Willmot, Kearney, Clarke, R. Clark, Thompson.

THIRD ROW: Davidson, Woods, Eaton, Ballagh, Miller, Taylor, Sweet, Farrar, Burnett, Bruce, Hoag.

SECOND ROW: Miller, Boyle, Sherwood, Stothart, Wheaton, McMillin, Walkey, Fleming, Jacobs, Zachanko, Hamilton, Gartshore.

FRONT ROW: Houle, Mitchell, Schmitt, Charters, Stavert, Rule, Jaffe, Self, Press, Ballantyne.



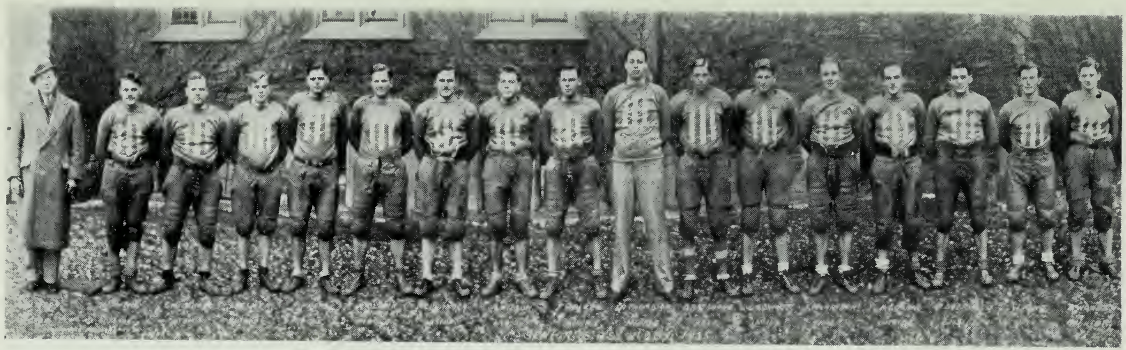
The Bronze "S"

ANOTHER chapter has been written in the annals of School athletics as Schoolmen have chosen from their long line of accomplished athletes the man most worthy of the symbol of athletic prowess and good fellowship, the Bronze "S." We congratulate our 118-pound gladiator of the ring, our gentleman boxer, Johnnie "Red" Millson, on being the proud owner of this mark of distinction.

Johnnie started his boxing career in first year with no experience and a lot of determination. That year proved his ability to take it as well as give plenty of it. The following fall he got his foot on the first rung of the ladder up by winning his weight in the Junior Assault. Last year, that is Johnnie's third year, was one long string of successes. In the fall it was the Junior Assault, in the winter the Senior Assault at O.A.C., making him top man for the University of Toronto. Shortly after, a team of fast and hard-hitting boxers came over from Syracuse University, a university noted for its boxers. Toronto won only two bouts and one of them was Johnnie's. Following this was a trip to Cornell where he again demonstrated his superior boxing. Capping it all, he was the only Toronto boxer to win the Intercollegiate at Kingston, giving him a first "T."

Not content with this, last summer saw him at the helm of the University Senior Rowing crew. At the Henley, as "cox," he guided the crew to second position, close behind the Detroit crew, classifying them as Canada's best Junior heavy crew. Then at McGill last fall they captured the "Intercollegiate" with a bigger lead than ever before.

This winter Johnnie was again winner of the Senior Assault and again represented Toronto at the Intercollegiate. Though we think of Johnnie as an Athlete who has brought more than his share of honour to School we cannot help but also think of him as the man in the lab. who can wield a slide rule with the best of them and always get the decimal in the right place.



SENIOR SCHOOL RUGBY 1935-36

LEFT TO RIGHT: R. Allison (Coach), G. W. Phene (Outside), T. Mitchell (Outside), Lotimer (Outside), T. Press (Middle), R. Clark (Manager, Middle), P. Cavanagh (Inside), A. Wilson (Inside), F. Walker (Snap), A. Thompson (Middle), J. Gartshore (Half), D. Schmitt (Inside), J. McArthur (Half), A. Gooch (Outside), M. Sherwood (Outside), W. Ring (Half), B. Woods (Quarter).

Senior School Rugby

With practically the entire Junior team of last year moving up into Senior company, prospects for a championship ran high this season. Then, too, the Schoolmen were very fortunate in procuring "Butch" Allison, stellar Argonaut outside, as coach.

Training, as usual, was carried on under great difficulty, practices having to be carried on most of the time under darkness due to the fact that "Labs" could not be skipped continuously. However, when the first game rolled around our Coach had a team that shaped up favourably and even showed a flash of colour in the backfield.

The initial game with Sr. Meds resulted in a scoreless tie, and from the spirit the Engineers put into that battle it seemed certain that the Mulock Cup was going to visit us again. The second game ended with a 6-0 win over the newly-entered St. Michaels' squad but injuries began to loom ominously over our team's hopes. Three of the regular squad were forced to retire at this point and, although the Dents were capably handled in the next contest, the team appeared to be weakening rapidly. Consequently the next three defeats were not totally unexpected, although somewhat disheartening, after such a beginning.

To mention any individual as a star is perhaps unfair as every member gave his best. Perhaps some men were a little better than others on the play but a Rugby Squad is not dependent on its stars as much as on whole hearted team spirit which the boys gave in full earnest.

I would like to take this opportunity of thanking "Butch" Allison for his untiring and unrewarded efforts to mould the team into championship calibre.

In conclusion, I wish next year's team the best of luck and hope they may be successful in bringing home the coveted "Mug."

R. L. Clark,
Manager.

S.P.S. JUNIOR RUGBY TEAM

Soccer

Congratulations to Victoria College on winning the Arts Faculty Cup!

The S.P.S. championship team of the previous year was riddled badly by graduation and examinations. Only two members of the team answered the roll call. But the old "School Spirit" is still strong.

At the first practice, twenty-five embryo engineers turned out. Under the guidance of Professor Allcut and Mr. Mat Ward, a former Varsity soccer star, a team was built up that reached the finals.

The School Team won their group by defeating Pharmacy 4-0, 4-0 and Wycliffe 4-1, 1-0. These games rounded the team into shape for the playoffs.

Dents drew the bye, leaving School and Vic to battle it out first.

The first game was played in the pouring rain, and resulted in a one-all draw. The second game saw School leading at half time 3-2 on the round. But the experience of our opponents enabled them to finish in front 4-3. School put up a great battle and went down fighting.

With the experience gained this year and all the players, except three, returning, next year's team will be one of the best soccer teams yet produced in the Little Red Schoolhouse.

Junior School Rugby

At the first of the year a large number of hopefuls answered the call to turn out for rugby and it looked as if Jr. School was going to go places. Alas, however, the opposition had improved also and due more to poor luck than poor playing or being outplayed the team was unable to get out of its own group. Even in the games which they did lose they were not beaten until the final bell had been rung and the scores totalled.

Much of the credit for the success which was attained by the team is due "Bud" Auburn of Argos and his untiring efforts to build up a fighting team. Thanks "Bud," the boys appreciated it.

As there were a number of Frosh on the team, next year's aggregation will have a good start to build up a winning team and those players who will not be on the team wish them the best of luck.

JACK FOX,
Manager.

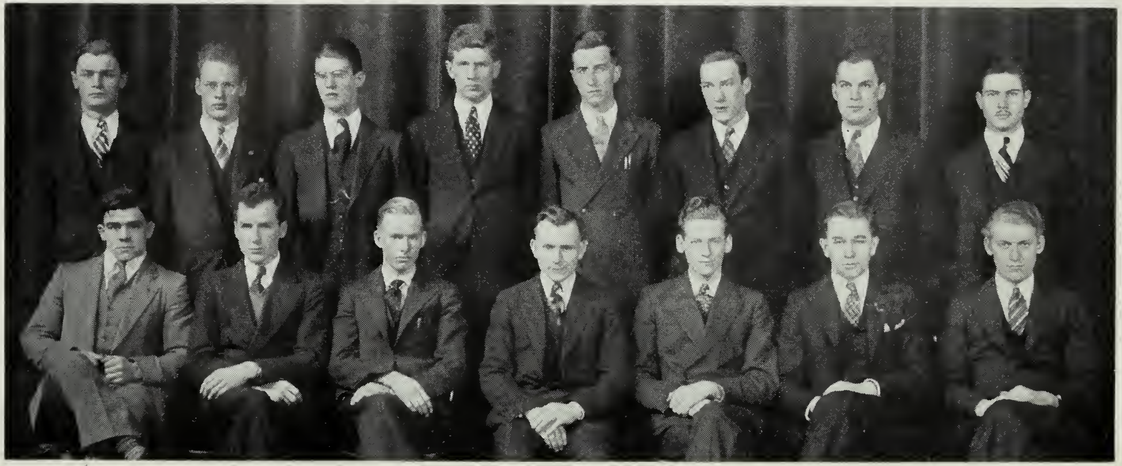
S.P.S. SOCCER TEAM, 1935-36 SEMI-FINALISTS

BACK ROW: A. D. Moore, B. Marks, A. C. Elliott, J. B. Jaffe, J. F. Tuke.

SECOND ROW: Professor E. A. Allcut (Hon. Coach), G. H. Maynard, G. C. Powell, J. I. Thompson, Mr. M. Ward (Coach).

FRONT ROW: W. R. Jackson, J. E. Kerr, R. H. Self, (Manager), H. B. Ashenhurst, R. M. Chute.

ABSENT: M. R. Mitchell (Captain), J. C. Link, C. E. Mudie, W. B. Woods.



S.P.S. B.W. & F. TEAM

BACK ROW: W. B. Woods, M. D. Stewart, J. Graham, J. Pigott, R. T. Wilson, E. W. Watt, A. B. Scott, E. L. Dodington.

FRONT ROW: A. U. Houle, J. Millson, A. K. Walton, H. L. Minaker, B. Moriarty, J. R. Rodzik, R. L. Cavanagh.

ABSENT: D. W. Lathrop, R. Grasley, F. N. Smith, D. H. McLaren.

School B.W. and F. Team

The fact is well known that from "School" come the toughest Athletes on the campus, and this year the boys on the B.W. and F. team proved it in no uncertain terms. This has been the most successful year for the team since 1930-31.

The Jr. S.P S. assault held early in December, to give the newcomers experience, was a weak (not week) affair due to the lack of entries. In fact it was so poorly contested "The Varsity" expressed its sympathy for future Intercollegiate teams if the interest in this sport from its largest contributor should wane. The following men won their weights: Wrestling, Dawe 135, Rodzik 145, Boyd 155. Boxing: Gandier 135, McLaren 145.

The turn-out for the Junior Interfaculty Assault was very gratifying and the superiority of the boys from S.P.S. was very much in evidence. All weights were keenly contested and School won the assault handily by winning four out of six boxing events and three out of six wrestling events. R. T. Wilson carried off the honours in fencing. The Champions from "School" were: Boxing—B. Moriarity 125, J. Graham 145, W. B. Woods 155, J. Pigott 165. Wrestling—J. R. Rodzik 145, A. U. Houle 155, D. W. Lathrop 175.

Other men such as Dodington, McLaren, Grasley, Boyd, Watt, and Scott won their way into the semi-finals and finals, but were finally nosed out.

After the holidays, the boys in the cauliflower trade really got down to training in preparation for coming interfaculty and intercollegiate honours. Three of our grapplers came through with wins for Varsity in the home and home International wrestling meets with the University of Buffalo. Fred Smith and Johnny Millson obtained much experience and popularity in their fights at the Maple Leaf Gardens.

The fight for the Davidson Cup, emblematic of Sr. interfaculty superiority, took place on Feb. 12-13 and what a scare we gave them. We had nine men on our team while O.A.C. brought down twenty-three (men?) O.A.C. won by a score of 52-48. Our winners were; Boxing—Millson, Smith, Pigott. Wrestling—Houle. The Sr. assault shattered my belief in the law of averages. We got all the bad breaks. O.A.C. also had four champions, but two of them were won by default, each counting ten points. *If* Pigott had had an opponent in his weight (he beat the O.A.C. heavy in an exhibition bout) we would have obtained six more points. *If* the heavyweight boxing had not been defaulted they would have received ten points less. Whitey Lathrop, a sure winner in the heavyweight wrestling division, was out with a cracked rib. Watt and Scott at 165 lbs. fought hard but dropped very close decisions. Boyd had a definite advantage at 155, but was forced to concede a fall due to an injured shoulder. Minaker.

the 135 lb. scrapper, battled his way into the finals and forced his opponent into overtime before losing the decision. Walton, a coming champion, fought hard, but lost to his more experienced rival at 118 lbs. Thanks boys for your whole-hearted co-operation, supreme efforts and wonderful achievements in upholding the standard of S.P.S. in interfaculty sports.

Five of the sixteen men on the Sr. Intercollegiate team were Schoolmen, namely: Millson, Smith, Pigott, Houle, and Lathrop while Art Scott made the intermediate intercollegiate team.

This year the Bronze "S" was awarded to none other than Johnny Millson the 118 lb., intercollegiate whirlwind from School. Johnny's record as a boxer during the last four years has been paralleled by few and beaten by none. Nice going, Johnny, and how the team will miss you next year!

A. U. HOULE,

Manager.

S. P. S. Outdoor Track

As far as track activities were concerned, School did not fare as well this year as has been her custom in the preceding years. The rivalry between the boys from the "Little Red Schoolhouse" and the chaps from University College which so often results in victory for the former, this year met with the opposite fate, and, as a result, S.P.S. is no longer the proud holder of the Interfaculty Outdoor Championship.

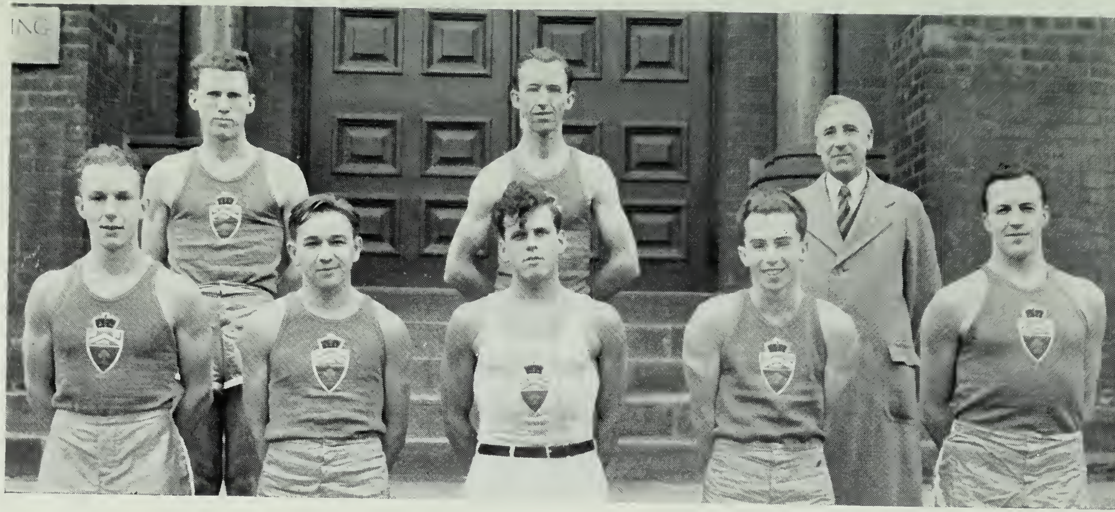
Although alibis are always distasteful, yet, I think it would be permissible to state that this year's team was not of the calibre of last year's, either in numbers or in average capability, and this may be explained by the graduation of several of the more brilliant men of last year's team. Coupled with this was the lack of response from freshmen which is of vital importance to the success of such a team.

The fine performance of Ashenhurst in the sprints and the totally unexpected fine showing of our relay team in winning the championship were the highlights of the meet.

It is to be hoped that, next year, there will be a renewed spirit of enthusiasm regarding track, especially among the freshmen. We have the ability men! Let's use it!

JOHN A. MCARTHUR,

Manager.



S.P.S. OUTDOOR TRACK TEAM, ROWELL MEMORIAL CUP DEFENDERS, 1935-36

BACK ROW: P. H. Hawker, F. A. Fleming, Prof. E. A. Allcut (Honorary President).
FRONT ROW: J. A. McArthur (Manager), J. R. Rodzik, D. B. Creighton, H. B. Ashenhurst, E. R. Eaton.
ABSENT: G. R. Bruce, J. M. Gandier.

Senior School Basketball

At the time of writing the Sifton Cup is still a bone of contention—but unfortunately we are not among the contenders. The usual alibis are with us—lack of a coach, lunch hours converted into basketball practices, injuries to Miller and Lotimer, etc., and all conspired to prevent the formation of a smooth working squad.

The team built around the splendid line of McArthur, Mitchell and Chernofsky started off inauspiciously by bowing to Senior Vic. In the return engagement, however, School rose to its greatest height and Senior Vic were beaten by one point.

The two following games with O.V.C. after a two week lay off resulted in a distinctly unpleasant surprise for School as the Vets turned out to be the "dark horse" of the league, and we ended the season on the short end of two closely contested games.

In conclusion, I would like to offer thanks to the team for their splendid co-operation and also a prayer for the return of the Sifton Cup, which is becoming a stranger around School.

J. Alex Wilson,
Manager.

Junior School Basketball

The junior team this year represented one of the strongest in recent years. The squad was composed of practically all new men, there being but one of last year's team.

In their first encounter, the team started off on the right road and downed a snappy Pharmacy squad by a 21 - 17 score.

The next game was against a more experienced and speedier Senior Meds team, who took a handy win by means of the field goal method, School finishing up on the wrong end of a 27 - 19 score.

But the boys were gradually improving, and proved this in the next clash with Pharmacy, whom they beat with a decisive score of 24 - 15.

The second encounter with Meds was a different story than the first. The battling engineers, although down in the first half, checked the Medicos to the floor in the final period and came through with a 17 - 14 win. By virtue of this victory, the team was tied for leadership with Sr. Meds, necessitating a sudden death game to decide the group winner.

The deciding game was an epic battle. School again were down at the half-way mark, but, staging a rally in the second period, tied the score. They then took the lead, which was, however, recovered

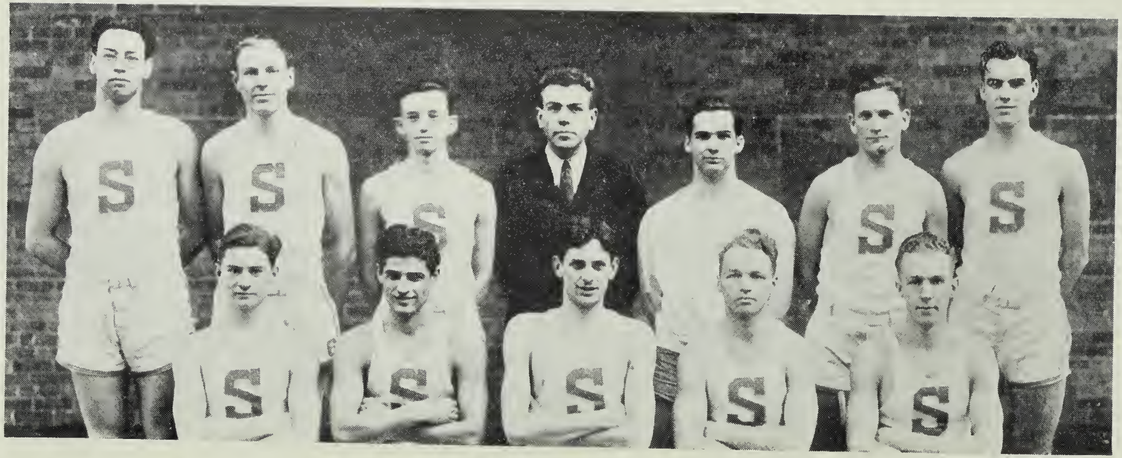
by Meds, and it was anybody's game until, in the closing seconds of play, Archibald sunk a foul shot giving School the winning point and group honours.

In the play-off round robin, the team broke even, winning two from Emmanuel and losing to Senior U.C., thus terminating the season's activities.

There were no outstanding stars on the team, but every man could be relied on to give his best, and the enthusiastic attendance at practices developed fine team work. This latter, combined with a determination to win, proved an adequate substitute for experience.

B. S. Wood,

Manager.



SENIOR SCHOOL BASKETBALL

BACK ROW: R. Thompson, T. Verity, L. Rosenblatt, A. Wilson (Manager), F. Taylor, J. Lilley, J. Dunn.
FRONT ROW: B. Woods, B. Chernofsky, R. Mitchell, R. Miller, J. McArthur.

JUNIOR SCHOOL BASKETBALL

BACK ROW. W. Walsh, C. Archibald, W. McRae, W. Rapsey, J. Fisher, A. Pilsworth, J. Johnson, A. Ferguson.
FRONT ROW: W. Usatis, B. Ballagh, B. Wood (Manager), C. Detweiler, C. Bishop.

SENIOR SCHOOL WATER-POLO TEAM

BACK ROW: Doug. Bruce, Bob Young, John Lilley, Harve Charters (Mgr.).
FRONT ROW: Ron Boyle, Bert Thompson, Vic Zachanko, Don Schmitt.

Senior School Water Polo

After years of trying, the Senior School waterpolo team turned it on this year, and emerged victorious from the struggle to the Eckhardt Trophy. In their group School had a rather easy time, beating University College by scores of 4-1, 4-1, and Senior Meds. 4-0 with everybody sharing in the scoring honours including Thompson.

In the semi-finals School drew Jr. Meds. and they proved plenty tough, as the first game was a tie, 2-2 and the second game went into six minutes overtime, until Ron Boyle pulled the Frank Merriwell act, and School finished on the long end of a 2-1 score.

The finals were played against Vic and the first game went to them by a score of 1-0, Vic scoring with a lovely tip-shot. But in the second game, School broke out in a scoring rash, started by Doug Bruce's goal after he swam from one end of the pool to the other. Vic Zachanko got two goals, and Morry Hollands one, and the game finished with a score of 4-2 on the round.

Junior School Water Polo

The Junior School Waterpolo team did not have very much success this year as the entire team was without previous experience in interfaculty competition. The team beat Dents in their one game by a score of 4-0, but Jr. Meds beat them twice by a score of 3-1. However, it was only lack of experience that beat them, as they always had plenty of fight and tried hard. If the team stick together next year they will be the team to beat for interfaculty honours.

We wish to take this opportunity to thank Pat Morgan for his untiring work in coaching the team.

R. A. Thompson,
Manager.

SENIOR SCHOOL LACROSSE

LEFT TO RIGHT: H. Charters, B. Hamilton, R. Martin, R. Bruce, F. Taylor, R. Stroud, G. Walkey, W. King, P. Gooch, P. Lindsay, A. Jacobs.

S.P.S Swimming Team

Again this year, School's natators, (together with other faculties) were forced to bow to the strong Trinity team in both Senior and Junior meets. A win in the diving, and the splendid victory of Jennings over Collins of Meds in the 200 yd. breast stroke event, netted School a grand total of ten points. The unfortunate illness of Otter, a sure point winner, was a great loss to the team, and caused a sacrifice of the free style and Medley Relay events. To climax a perfect evening, our star relay team was just nosed out of fourth place. However, a good time was had by all, and with the unveiling of lurking talent in the Freshman year, a brighter future is in store for next year. The honour of the School was upheld by Tedman, Buntin, Kilgour, Head, Jennings, Miller, Lilley, Wood, Sherwood and Grier.

B. S. Wood,
Manager.

Senior School Lacrosse

This season Senior School presented a much improved aggregation in the Interfaculty lacrosse loop. Several of the outstanding juniors of the previous season had moved up and with the veterans of three or four seasons on hand things looked to be well away. The way the gang turned out to practice was a rare good sign, but the jinx, or something, which has overtaken most School teams this year was clicking on all four. Injuries, etc., kept us from flooring a full team in all except one game.

The first game with Meds proved to be a runaway with Meds taking the count to the tune of 15 to 3. That game sent School's hopes high, but with no less than four of our stars absent Victoria outslugged us in the next encounter with the count 12 - 3.

Meds were again easy victims, this time falling by the wayside 12 goals to 5. Then came that fateful Saturday when St. Mikes took us 11 to 10 after School had at one time a five goal lead. That one was hard to take.

Though out of the running, the team carried on and were finally successful in knocking off Vic, with the score being 13 - 7.

Bob Stroud played an A1 game in goal with John Lilley, Perce Lindsay, Bill King and Ron Bruce as defence. The centre players were Ace Walkey and Al Jacob, who were both right on the bit all the time. Our doughty home men were Harve Charters, Frank Taylor, Pete Gooch and Hamilton. Corley Martin alternated in goal.

B. J. F. Hamilton,
Manager.

S.P.S. JUNIOR LACROSSE

BACK ROW: J. Russel, A. Breahey, G. Walthey (Manager), G. Wheaton.
FRONT ROW: M. Robinson, R. Rule, E. Brough, B. Bullagh.

SENIOR SCHOOL BASEBALL

SECOND ROW: D. W. Miller, D. G. Willmot, G. A. Walkey, P. W. Gooch, F. S. Quance.
FRONT ROW: R. L. Clark (Manager), F. W. Sweet, F. G. Walker, P. C. McMillin, R. L. Miller.

Junior School Lacrosse

Although the team did not win the cup again this year the boys played real lacrosse all year. The team has a torrid tie with O.C.E. to their credit. We were rather handicapped by our grouping and the unfortunate postponing of three frames. O.C.E. and Forestry were grouped with School and thus we only had four games. Forestry were easy victims in two games but the teachers walloped us once and the second game was a draw. After a lot of arguments, we played off with the teachers again and were soundly beaten, leaving no room for argument as to which team was the better one.

There was a fine turnout for the team which augurs well for the future of lacrosse at School. Everyone that turned out did not make the team, of course, and some good players were turned away. Russell, playing his first game in goal was tops. In Douglas, Kirby, Wheaton, and Rule we had the best set of defence men in the league. Up front Brough, Ballagh, Breakey and Robinson were regular goal hawks and never stopped trying. Needless to say we will be back again next year stronger than ever to try to bring back the cup to School where it belongs in the dusty corridors of the Little Red Schoolhouse.

G. W. Walkey,
Manager.

Senior School Baseball

Living up to traditions, senior school produced a team that shaped up very favourably according to those in the "know." The season opened with the Spalding Cup appearing within easy grasp, and since most of the men were from last years' semi-finalists, hope ran high for a championship (a very scarce thing around school this year).

As usual, the team was grouped with Pharmacy and our ancient rivals the "molarmen." Formerly these teams offered little resistance and just provided practice for future games. However this season proved to be a different story. The first games with our opponents ended in ties, although School had a slight edge in one if not both of the games. During the second encounter with the Dentists, defeat was accepted to the tune of 8-7. Pharmacy were again held to a tie, and after playing a tie-breaker, School was forced to place the ball and glove on the shelf until next season.

The majority of the team have been playing together for the past three years and as most of these men will be returning next year it is to be hoped that the "Mug" will find its way down to School.

Among those members of the squad who gave their full support were R. L. Miller, catcher, Marks and McMillin, the pitchers, Sweet, Willmot and Dick Miller on the bases, Chernofsky, Quance and Gooch in the infield.

It was certainly unfortunate that the squad did not advance further in the series. However, the boys worked hard and at all times played the game, which is really what counts. Having been eliminated this year, the next best thing is to look forward to next year and trust to luck.

R. L. Clark,
Manager.

Senior School Hockey

It was ever thus!

After completing a strenuous group schedule involving Dents, St. Mikes and Sr. Meds, this year's edition of School's Senior Hockey stalwarts entered the play-offs full of pep, without having lost a game.

In the first round of the play-offs, St. Mikes were finished off in short order to the tune of 9-2 on the round. Emanuel were the next victims, who were allowed to put away their equipment until 1937, after a score of 8-1 on the round had been attained.

Then, oh! oh! What's this? Vic again drawn against School in the Semi-finals? In this series, the boys fought desperately and went down gamely before a fast team which showed just a little more pepper around the nets, and as a result won two straight games.

The team was exceptionally well balanced and showed a wonderful spirit through their attendance at practices (even at 8 a.m.) and pep (?) talks and I would like to thank them all for their splendid co-operation. The line of Kerr, Willmot and Davidson displayed power with their speedy attacks at all times, while Woods, Walkey and Fisher, on the other forward line, produced some smart plays as well as showing excellent back-checking. Stroud, who played a spectacular game in goal, was ably protected by three good rushing defense men: King, Stothart and Press. Stickney, our other goal-keeper, although he saw no action in the games proved to be very good and was a great help at both practices and games.

The team as a whole sincerely appreciated the expert coaching of Phil Jeffrey and also the thoughtful consideration of members of the staff.

A. R. Thompson,
Manager.

SENIOR SCHOOL HOCKEY TEAM

BACK ROW: A. R. Thompson (Manager), W. B. Woods (R. Wing), A. Fisher (L. Wing), W. J. King (Defence), W. R. Stickney (Goal), P. O. Jeffrey (Coach).

FRONT ROW: A. B. C. Stothart (Defence), T. R. Press (Defence), G. W. Walkey (Centre), R. Stroud (Goal), H. M. Kerr, (L. Wing), D. G. Willmott (Centre), G. R. Davidson (R. Wing.).

JUNIOR SCHOOL BASEBALL

BACK ROW: R. Jackson, G. Wheaton, E. Horenbala, E. Russell (Manager), M. Robinson, W. Gibson, J. Fisher.
FRONT ROW: J. Ford, B. Moriarty, E. Jaffe, J. Milnes, A. King, W. Philpott.

JUNIOR SCHOOL HOCKEY TEAM

BACK ROW: H. M. Robinson (L. Wing), I. G. Wheaton (L. Wing), J. F. Ford (Manager), J. L. Smart (Defence), R. L. Cavanagh (Defence).

FRONT ROW: J. L. Hemphill (Goal), B. J. Moriarty (R. Wing), A. G. Breakley (Centre), N. W. Smith (R. Wing), R. J. Gillespie (Goal).

INSET: Left—J. R. Clements (Centre). Right—W. A. Pringle (Defence).

Junior School Baseball

At the beginning of the season our chances for a championship team appeared very slim, since most of last year's team had gone on to senior ranks. However, the opening practise found plenty of new material on hand, so that it was difficult to shape out a team. As there was no extraordinary pitching talent apparent, the team had to depend solely on its fielding and hitting strength.

Junior School was successful in its first game with Junior U.C., the score being 12-8. In the next game, however, they were toppled to the tune of 9-0 by the well-balanced Junior Meds. In the next game, Junior School defeated Junior U.C. by the close score of 11-10. In the last game with Junior Meds, School didn't seem able to find themselves and lost by a score not fit to be published.

In all, the season was not one of the most successful, but we are hoping to welcome back next year some of this year's men and form the backbone for a strong Junior School team.

E. A. Russell,
Manager.

Junior School Hockey

'Tis true, Junior School did not make the play-offs for the Jenning's Cup, but they were not outclassed by any means. Every game was a close, hard game and only the unfortunate shortness of the schedule kept us from getting to the top.

Grouped with Vic., U.C., Trinity and Jr. Meds., Junior School helped to form, probably, the strongest group in the league. Although successful against Trinity and Junior Meds., we went down to U.C. and Vic by scores of 2-0 and 4-1 respectively. Having to win the game against Vic, aggressive hockey proved our downfall and helped them pile up the score.

Our defence of Pringly and Smart with Cavanagh on reserve was exceptionally strong. Pringly besides being a "bang-up" defence man, was the team's leading scorer. This trio are all freshmen and it is hoped will all be back to form the base for next year's team. The forwards were all hard workers, each deserving credit. Goaler Hemphill also did a fine job in the net.

So here's hoping that the Jenning's Cup will come to Junior School in 1937.

J. F. Ford,
Manager.

S.P.S. GYMNASTIC

M. L. Sherwood, L. A. Patterson, W. H. Powell, J. C. Clark.

S.P.S. Gym Team

Although defeated by a narrow margin by both Meds and Trinity in the Interfaculty Gymnastic Meet in Hart House on February 5th, the enthusiasm displayed by School freshmen was most encouraging. Three of the aspirants were first year men from whom we may expect much in the future.

However, School's hopes of regaining the Harold A. Wilson Trophy this year were considerably frustrated when W. H. Powell had the misfortune to break a bone in his hand shortly after the meet commenced. A team composed of L. A. Patterson, J. C. Clark, and M. L. Sherwood carried on commendably.

Patterson was the only representative from S.P.S. on the Intercollegiate team this year.

M. L. Sherwood,

Manager.

S.P.S. RIFLE TEAM
E. G. Rosengren, J. E. Lee, F. B. Pickett, A. S. Foreman, W. R. Stickney
S. M. Rothman, R. L. Broad, W. R. Tutton

The Rifle Association

The University of Toronto Rifle Association is a non-military club composed of undergraduates and graduates (male only, hang it!) of all faculties of the University, with an enrolment of 150, and S.P.S. much in predominance as usual.

Practices are held several days a week in the fall at Long Branch (watch the Varsity for dates), where shooting is carried out at 200, 300, and 500 yards with the 0.303 rifle and service ammunition. On some fine Saturday before the snow falls, (on which date the members in S.P.S. are officially excused from their labs, as if that made any difference), the outdoor match is held. This usually takes place at the above distances, but this year, due to a fog which made the targets invisible at 200 yards, the range was curtailed somewhat. School came out on top this year for the second successive time to win the Delury Shield, and most of the medals and cash prizes. The team for S.P.S. consisted of R. L. Broad, F. B. Pickett, S. M. Rothman, E. G. F. Rosengren and J. E. Lee. The highest five scorers in each faculty are chosen as a team, so everyone has an equal chance of getting on it.

To escape the wintry blasts, the members seek refuge in the finest indoor range in Toronto, situated near the locker room in Hart House. Here the membership is divided into four classes, according to ability, and each month two cups are given in each group for the highest scores on a specially designed target. Of the 24 cups given this year, School won about 18 (we lost count after the 12th) thus demonstrating the value of liquid refreshments for steadying the nerves. In these same months each man shoots three Mitchell Cup matches, as well as hosts of practice targets. Here again the top five in each faculty make up its team, and for S.P.S., W. R. Tutton, A. S. Foreman, F. B. Pickett, R. L. Broad and W. R. Stickney managed to beat Arts, Meds, Dents, Etc., to carry away the Mitchell Cup for the fifth year in succession.

The Univeristy team, made up of seven Schoolmen and a graduate won the Toronto Indoor Rifle Leagues' series of nine matches this year. It is of interest that two of these came first and second in the city when the smoke had cleared away and the final scores were totalled.

Other points of interest are the novelty match, in which prizes are given to poor shots as well as good ones, and the two banquets which are held during the year.

The shooting for this year is over; let's all join early next year. If you can shoot we need you; if you can't we'll teach you.

R. L. Broad,

Manager.

"C" Company C.O.T.C.

The University of Toronto Contingent of the Canadian Officers Training Corps was organized, as its name implies, to give training to men of University calibre in "the principles of Leadership of men." It consists of four Companies of which "C" Company is the Applied Science Company.

In addition to offering a very popular and interesting method of obtaining one's Physical Training in the University course, the Corps provides instruction leading to Certificates of qualification for the ranks of Lieutenant and Captain in the various branches of the defence forces. Members of "C" company may elect to take training in Artillery, Survey, Engineers, Signalling, or Infantry. This training is a valuable supplement to the academic courses of the Faculty, consisting of the application of Science to practical projects. Instruction in Engineering consists of the actual use of engineering materials and quick and empirical methods of design, such as in the building of bridges, embankments, derricks, scaffolds, etc.

The signalling group spend their time with telephones, lamps, buzzers, radio and other equipment used in sending messages over long and short distances, which is an opportunity no electrical Engineer should miss.

In the Artillery and Survey courses the work of surveying, map making and reading, gun laying and organization of parties of men are most interesting to Engineering students in general.

The Infantry course specializes in the organization, administration and handling of men in various projects and training in the ability to appreciate or size up a situation rapidly.

Instruction is carried on during the regular physical training hours and also between 5 and 6 p.m. for those desiring special instruction, or unable to attend at other times.

Opportunities for promotion are available to those who qualify for same, as the majority of commissioned officers and all the noncommissioned officers of the Contingent are undergraduates.

The annual C.O.T.C. Ball is possibly the most brilliant social function "on the Campus." It is held in Hart House and since the numbers are strictly limited, members of the corps have first opportunity of obtaining tickets, and if any are then available guests may obtain tickets at considerably higher cost than to members.

Although the Contingent is a unit of the Active Militia of Canada, and members draw pay at the end of the training season, they are, apart from the commissioned officers, no more liable to be called for active service than any other citizen of Canada.

It is also worthy of note that the training offered in the Corps is the only method of obtaining qualifications as Officers in the defence forces of Canada and the Empire without first obtaining a provisional commission in a militia unit.

The orderly room, library and lecture room are located at 184 College Street (just west of the Mining Building) where further information may be obtained.

THE UNIVERSITY OF TORONTO ENGINEERING SOCIETY

BALANCE SHEET

AS AT 31ST MARCH 1936

ASSETS

1935			
	CURRENT ASSETS		
$ 75.52	Cash on Hand .... $	47.56	
2,222.49	Bank Balance—Savings	2,528.02	
598.13	Accounts Receivable	619.37	
8.00	Suspense—Returned Cheques	1.00	
2,447.59	Merchandise Inventory	2,231.51	$ 5,427.46
$ 5,351.73			
	INVESTMENTS		
	Dominion Government and Government Guaranteed Bonds		
4,000.00		4,000.00	
91.17	Add Accrued Interest	41.17	4,041.17
$ 4,091.17			
	FIXED ASSETS		
1,288.57	Office Equipment	1,327.39	
864.86	Less Reserve for Depreciation	961.17	366.22
$ 423.71			
	DEFERRED EXPENSE		
26.66	Unexpired Insurance		13.33
$ 9,893.27			$ 9,848.18

LIABILITIES AND SURPLUS

	CURRENT LIABILITIES		
$ 1,301.00	Accounts Payable .... $	1,654.78	
320.96	Bank Overdraft—Current Account...	177.07	$ 1,831.85
8,271.31	Surplus Account		8,016.33
$ 9,893.27			$ 9,848.18

OPERATING STATEMENT

1ST APRIL 1935 TO 31ST MARCH 1936

1934-35			
$11,018.21	Sales		$ 11,479.34
2,328.11	Inventory 1st April 1935 .... $	2,447.59	
8,220.41	Purchases	8,237.13	
10,548.52		10,684.72	
2,447.59	Less Inventory 31st March 1936.......	2,231.51	
8,100.93	Cost of Goods Sold		8,453.21
2,917.28	Gross Trading Profit		3,026.13
1,590.50	Salaries		1,639.10
$ 1,326.78	Net Operating Profit		$ 1,387.03

THE UNIVERSITY OF TORONTO ENGINEERING SOCIETY

STATEMENT OF INCOME AND EXPENDITURE

1ST APRIL 1935 TO 31ST MARCH 1936

1934-5			
	INCOME		
$ 1,326.78	Net Operating Profit from Supply Department	$ 1,387.03	
1,590.00	Fees	1,528.00	
200.21	Interest and Discount	215.97	
8.92	School Formal		$ 3,131.00
	Excess of Expenditure over Income to Surplus Account		254.98
$ 3,125.91			$ 3,385.98
	GENERAL OPERATING EXPENSES		
$ 367.25	General Expenses	$ 293.08	
279.50	Grants to Affiliated Clubs, and Scholarships	194.21	
125.46	Donations	165.09	
266.26	Dinner—Deficit	240.89	
148.06	Election Expense	112.47	
116.96	School-Nite	169.86	
320.80	Photographs	282.50	
724.84	Publications	1,270.06	
92.43	Depreciation—Office Equipment	96.31	
18.34	Insurance	18.33	
	Printing and Stationery	58.20	
	School Formal	46.02	
	Convention Expenses	438.96	$ 3,385.98
$ 2,459.90			
666.01	Excess of Income over Expenditure to Surplus Account		
$ 3,125.91			$ 3,385.98

SURPLUS ACCOUNT

1ST APRIL 1935 TO 31ST MARCH 1936

$ 8,438.30	Balance 1st April 1935		$ 8,271.31
666.01	Excess of Income over Expenditure for year ended 31st March 1935		
$ 9,104.31			
	Excess of Expenditure over Income for year ended 31st March 1936	254.98	
$ 833.00	Dividend on Fees		
8,271.31	Balance to Balance Sheet	8,016.33	
$ 9,104.31		$ 8,271.31	$ 8,271.31

« Autographs »